Competitive pressures on income distribution in China

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ter verkrijging van de graad van doctor aan de Katholieke Universiteit Brabant, op gezag van de rector magnificus, prof. dr. L.F.W. de Klerk, in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de Ruth First zaal van de Universiteit op

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door

HAORAN PAN

geboren op 5 december 1963 te Shenyang, China

PROMOTOR: Prof. dr. A.H.O. van Soest
COPROMOTOR: Dr. M.H. ten Raa

To my mother
and my son, Jiliu

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Contents

Chapter 1

Introduction

1.1 What will a market economy do to income distribution in China?

It is curious, indeed, that while most economies over the world stagnate, the socialist Chinese economy has been growing noticeably in recent years. Economists and others attribute the achievement to the market-oriented reform started in 1978 in China. At present, the reform is on track, but the fact remains that China still has a long way to go from a market economy. The government, for example, still owns the majority of production inputs and factories and controls the main part of the economy. Just how far away, then, is the current economy from a market economy? In what other ways will the market reform impact the Chinese economy? To answer these questions, this study attempts to model a hypothetical market economy in China, based on modern economic theory. The model is computable, and its solutions reflect market economy features–particularly profit maximization.

To narrow down the examination, this study chooses one aspect of the economy, focussing on the issue of personal income distribution. This particular issue was chosen because the influence of the reform on income distribution has been remained one of the most ambiguous problems in the Chinese economy. Discussions on the topic have centered around three questions: What is the current situation with regard to personal income distribution? How will the situation change with the economic reform? Finally, is the distribution equitable? While the first and second questions seek to describe the problem, the third question delves into the welfare aspect of personal income distribution. This piece of research works entirely on the first two questions,

and has nothing to do with the third one. In that sense, this is positive rather than normative research. It does not explore the optimal distributive patterns and policies. Rather, it is meant to describe the generation and distribution of income. The study investigates the income distribution in order to answer to the following questions: What are income differences between geographical regions, between economic areas, and between social classes in the current markets and in the hypothetical competitive markets in China? Compared to the current economy, will the income inequality in the market economy increase or decrease? Who will be the beneficiaries?

Research into income distribution has formed two branches: the functional income branch, which deals with income distribution to production factors, and the personal income distribution branch, which deals with income distribution among persons. Traditionally, the two branches are isolated. Personal income, of course, was approached by personal characteristics such as age, sexy, chance, genetic ability, education, saving propensities, bequests, inheritance, etc., which were not related to economic structures. The isolation of personal income distribution from functional income distribution has held back research on personal income distribution. Recently, the branch of personal income distribution tends to go in a new direction: personal income is approached from an economic point of view that holds that economic fundamentals determine income. This approach connects functional with personal income distribution. It is difficult to reconcile the two different regimes of income distribution, but recent developments in economic modelling have shed new light on this possibility. In particular, since 1970s a number of applications on developing economies have explored the field.[1] This research is one such attempt. Its idea is as follows: Personal income is accounted for by the ownership and prices of personal endowments. Given fixed ownership, personal income depends on the prices of endowments. According to neo-classical theory on functional income distribution, in competitive markets, the marginal productivity of a resource determines its price. In turn, once resource prices are known, personal income becomes traceable. Therefore, the core of this study is to discover a benchmark distribution of income in a competitive economy. First it will construct and solve a general equilibrium framework in which competitive wage and rental rates are generated according to the marginal productivity of labor and capital in competitive markets. Subsequently, the study will transform the functional to the personal income distribution.

[1] For a broad review, see Dervis et al. (1982), and Shoven and Whalley (1992).

The general equilibrium model in this research is constructed as follows. China is considered to be an integrated economy, with trade connections with the rest of the world. However, international trade is fixed – it is considered as a kind of external source. The objective of this economy is to maximize its overall domestic final uses. China has 30 provinces, each of which is an independent economy. This research classifies each provincial economy into 30 commodity and service sectors. Trade between provinces is completely free, and 29 commodities are considered to be tradable, while public administration is considered to be nontradable, based on the observation of trade account that all provinces have no exports and imports in this commodity.[2]

Production and services have inputs of intermediate products, labor and capital. According to the traditional approach, fixed capital is an immobile factor. In the model, it is assumed to be sector specific, which means that each sector uses a specific type of capital. The model classifies labor by skill level into four types, namely unskilled, skilled, manager and technician. Theoretically, in the competitive markets in which agents are utility-driven, labor is a mobile factor. This model incorporates three types of labor motions: substitution from high to low skill, moving among sectors, and migration among regions. According to human capital theory, different skilled labor matches different marginal productivity, higher skilled labor is able to replace lower skilled labor. This kind of substitution can be easily observed from real markets – a mathematician is doing a programmer's job, an engineer becomes a department manager, and so on. The model considers a hierarchy of substitution in the sense that a technician is able to substitute for the other three, a manager is able to substitute for skilled and unskilled, and skilled worker is able to substitute only for unskilled worker. Moreover, labor motion among sectors is a more common phenomena in the markets. The model allows labor to be freely mobile among sectors by introducing the incentive to seek for more income. However, migration is a complex matter, because while migration brings income gains, it also involves some losses to the migrant. For example, hometown loss is one of the most important concerns. In most people's opinion, the hometown's utility is the one that cannot be matched by a certain amount of increase in income. Because of the fact and also the concern that specific investigation on all kinds of migration utility gains and losses may drive the research too far away from the mainstream, this model simply assumes that labor prefers any non-zero low income to migration. This means that as long as a worker

[2]Provincial input-output tables in China, 1992.

can earn some income, he/she will not migrate to seek for more. In the model, because of the substitutive effect, skilled workers, if losing their jobs, will prefer occupying low positions to migrating. Unskilled workers have no room for substitution, and therefore have to migrate if their work becomes redundant in local markets. Therefore, in the model, technicians, managers and skilled workers are considered to be mobile between sectors within a province, while unskilled workers are mobile all over China.

The empirics of this research solve the model on the basis of real data on the Chinese economy in 1992. The results simulate a competitive set-up of the Chinese economy, where competition drives resources to be allocated optimally, forces some sectors to be cut back or eliminated, and stimulates some sectors to expand. As a result, the competitive economy is an efficient one; the difference from the current markets therefore measures the inefficiency in the current economy. The most important result for this research is that the empirics expose the functional income distribution in the competitive markets; when resources are fully employed, they are valued by the marginal products, which equal to the efficient rental and wage rates. Subsequently, given ownership of resources, the personal income distribution emerges under perfectly competitive conditions.

In practice, personal income distribution is often investigated with respect to income inequality. There are many methods proposed to measure income inequality numerically, but different measures may yield different conclusions. In theory, none of these measures can be superior over all others, because each of them has its own specific purpose, meaning and use. This research adopts Theil's index to measure income inequality. Theil's index has nice properties, particularly its additive decomposition ability and monotonity over group inequalities. However, note that Theil's index does not directly suit this research, because it approaches the within-group inequality by exogenous statistical distribution. The empirics in this research avoid depending on any exogenous estimations on income distribution within the group, and therefore develop Theil's index into an extended form that includes multiple groupings until all within-group inequalities disappear and overall inequality is the sum of all between-group inequalities. As a result, the extended Theil's index provides more systematic information on income inequality than the original one.

The empirics apply the extended Theil's index to measure income inequality in both the current and the hypothetical competitive Chinese economy. The applications investigate income inequality to the extent that the overall inequality, the inequality between social classes, in and between areas, and in and between regions, are all

revealed. The former application has two purposes: identification and clarification. Income inequality has been studied intensively during the reform period in China, but so far there exist few systematic and consistent studies and conclusions on the topic. The application investigating the current situation of income inequality is a new attempt, which is expected to present systematic and consistent information. Although many conclusions on income inequality have been drawn by other research, they are often contradictory and controversial. This application is used to examine the conclusions from other research. Some of the conclusions are compatible with them, others are not. Of importance, however, is that the application serves as a comparison with the income inequality in competitive markets. The latter application aims to reveal the impact of competition on income inequality, and to further point out the winners and losers.

The main ideas of this research are as follows. First, as opposed to traditional theories on the size distribution of income, this research follows the new direction of approaching the size distribution of income in connection with the functional income distribution. The analysis is based on neo-classical theory, which says that in competitive markets, the marginal productivity of resources determines their prices. Once the prices are known, personal income becomes traceable. Second, this research simulates a full market economy by constructing a general equilibrium model, which differs from other models in that it specifically considers China as an integrated economy in which competition occures between China's provincial economies and their sectors. In addition, the model allows for the substitution from high to low skilled labor and the migration of unskilled labor, and considers fixed capital to be sector-specific. The hypothetical Chinese market economy will eliminate the inefficiency of labor misallocation in the current economy and reveal the efficient functional income distribution, which is then transformed into personal income distribution. Third, this research develops an extended form of Theil's index, using this to investigate the income inequalities in the current and the hypothetical Chinese economy, respectively. Finally, conclusions are drawn, based on the comparison of income inequalities in the competitive markets and in the current markets.

1.2 The outline of the thesis

The thesis comprises the three parts of economics: theory, modelling and empirical analysis. The theoretical part is presented in chapters 2 and 3; chapter 2 develops a theory of income distribution, while chapter 3 considers the measure of personal income distribution. Chapters 5 and 6 introduce and present the model, which simulates functional income distribution in competitive markets. Empirics are covered in two separate chapters: the current Chinese economy in Chapter 4, and the hypothetical competitive Chinese economy in Chapter 7. Chapter 8 concludes the research.

Chapter 2, which sets up a theoretical basis for this research, attempts to answer the following questions: How is income defined? To whom is income imputed? Where does income come from? How is the final income formed? Finally, what causes differences in the distribution of personal income?

Income can be studied from two angles: its sources or its uses. With regard to its sources, income is the sum of wages, salaries, interest, rents, dividends, pensions, various subsidies and allowances, donations, support payments, and inheritances. With regard to its uses, income consists of consumption, saving, investment, taxes, and bequests. Taubman (1978) maintains that a comprehensive income should also include nonmarket activities such as income imputed to owner-occupied houses, the value of self-provided goods and services, and capital gain on assets. Theoretically, as Simon (1938) defined, income is the sum of the market value of rights exercised in consumption, and the change in value of the store of property rights between the beginning and end of a certain period. Practically, however, this research defines income from its sources: it is the sum of earnings, rents, subsidies, and inheritance (where the earnings represent wages and salaries, the rents include interest and dividends, the subsidies consist of pensions and other allowances, and the inheritance contains donations and support payments).

With respect to functional income distribution, income recipients are factors. With respect to personal income distribution, income recipients are persons. In both theory and practice, the 'persons' may refer to either households, families or individuals. This research chooses the individuals as income recipients to classify the persons precisely. According to income sources, there are wages, rent, subsidy, and inheritance receivers. Under certain circumstances, the four types of receiver may overlap. For example, a low-income earner may also receive subsidies for living; a rent receiver may work for wages as second income source. Yet, subsidy, as a form of transfer income, has

not been broadly applied to other groups of people except for the retiree. Because this research focusses particularly on the Chinese economy, in which few people have multiple income sources, it ignores the overlapping by assuming that each person has only one income source. In particular, the person who receives wages is called 'labor', the person obtaining rents is 'capitalist', the person who depends on subsidies is 'transfer income dependant', and the person relying on inheritance is 'family income dependant'. Labor as a group is divided further into unskilled, skilled, manager and technician according to skill level. The transfer income dependant is specific to retiree. The family income dependant comprise junior, senior, unemployment, disability, housework, and student.

Although personal income is observed with three sources (namely primary, transfer, and family income flow), the original source is the primary income. Both transfer and family income are, in fact, the redistribution of primary income. Neo-classical economists have concluded that primary income is generated in production. According to neo-classical theory on functional income distribution, factors extract income from the production in which they participate; since labor and capital are the principal factors, labor receives earnings and capital gains rents. The earnings and rents therefore constitute primary income. In an economic system, income distribution does not end at the primary stage, but is distributed further. Transfer income is formed with taxation and other forms of charges collected by public sectors, mainly over primary income. Family income comes from the primary income earner in family. The entire procedure of income distribution therefore consists of three times distribution: primary, transfer and family income distribution. After the three distributions, everyone has their final disposable income.

Final income is different between persons. In reality, it is difficult to explain the difference in personal income. So many factors influence income, and some factors are not understood, or have even been observed, yet. In theory, however, it is possible to approach income difference. According to neo-classical economics, under perfect competition, resources are valued by marginal productivity. The difference in the marginal productivity of resources therefore causes the difference in wage and rental rates. Given the ownership of capital, functional income can be transformed into personal primary income, thus exposing the difference in primary income. Furthermore, if data on public transfer programs are available, the difference in transfer income can be calculated. Using the assumption that income is shared within the family, and combining this with basic knowledge on family structure, family income difference can

be derived. Finally, the difference in final income is revealed.

This research is an application based on the above theoretical structure. It models a hypothetical competitive economy to generate functional income distribution under perfect competition. By observing capital ownership in a real economy, the application transforms functional income into personal primary income. For simplicity, when the application investigates transfer income distribution, it uses the observed program of public transfer that specifies that the retiree is the sole receiver of transfer income, and that the retirees' income is the mean of working people's earning. When deriving family income, the application employs the observed dependency ratio, which is the dependency population over the working population. After having obtained the final income of persons in a competitive economy, the application uses inequality measures to evaluate the distribution of personal income.

A quantitative measurement of income inequality is important for the study of personal income distribution, as it provides explicit and precise information to reveal the ranking of income distributions. Chapter 3 is therefore devoted to finding out a proper measure that best suits the need of this research. Sen (1972) and Kakwani (1980) have summarized various popular measures such as the Relative mean deviation, Variance, Coefficient of variation, Variance of logarithms, Standard deviation of logarithms, Gini coefficient, Theil's index, Dalton's measure, Atkinson's measure, Sen's measure, etc.. Among these, it is hard to select one as better than the others, because each of them has special explanation on income inequality. However, through plenty of work on theory and practice, economists have realized that some measures may not be qualified, and have proposed that a qualified measure of income inequality should possess certain properties. In general, four properties are considered to be essential: the Pigou-Dalton income transfer principle, Symmetry, Income homogeneity, and Population homogeneity. Certain research recommends Additive decomposability as an important property. Foster (1983) proved that Theil's index was the only one satisfying all five properties. Shorrocks (1988) found out that the additive decomposability of Theil's index had the particularly interesting property of subgroup monotonity.

Normally, Theil's index consists of a between-group and a within-group inequality. While the between-group inequality is accounted, the within-group inequality is obtained by assuming a distribution form. This dependence on the assumed or observed distribution within groups restricts the direct application of Theil's index. Because additive decomposability can be used to study between-group inequality, this research

develops an extended form of Theil's index, in which the total inequality of Theil's index is the sum of a number of between-group inequalities – while the within-group inequality is zero. With the extended Theil's index, the population of individuals are classified into different income intervals for several times; the number of the classification times should be no less than the number of types of income-determining factors, so that the individuals in same group have identical income. This method, in fact, breaks down total inequality into various between-group inequalities and leaves within-group inequality to be zero. The extended Theil's index is used to measure income inequality in the current Chinese economy in Chapter 4, and in the hypothetical competitive Chinese economy in Chapter 7.

This research attempts to shed light on how the hypothetical competitive market in China differs from the current situation in terms of personal income distribution. Important, in the first place, is a good understanding of the current distribution of personal income in China. Chapter 4 investigates the current situation of income inequality in China by using the extended form of Theil's index developed in Chapter 3. This work is meaningful in three aspects. First, it presents systematic and detailed information on income inequality, which has not been provided by other research before. Second, compared with the conclusions provided by other research, the results of this work will add some new comments on the current income inequality in China. Third, the results will be used in a comparison with the hypothetical situation of income inequality in the competitive Chinese economy.

Chapter 4 measures income inequality regarding the real economic situation in China. China is still an agricultural country; the majority of the population resides in rural areas, and there is an obvious distinction between the rural and the urban economies. For this reason, income inequality in general is investigated with respect to three aspects: inequality in rural areas, in urban areas, and between rural and urban areas. It is conjectured that rural China has more income inequality than urban China. Much research has supported this reasoning. The State Statistical Bureau calculated that the Gini coefficient was 0.236 for urban areas in 1987. Zhu and Wen (1990) calculated the national Gini coefficient for rural areas in 1988 as 0.3014. Griffin et al. (1994) calculated that the Gini coefficients were 0.334 in rural areas and 0.233 in urban areas in 1988. Wang et al. (1995) found that the Gini coefficients were 0.331 in rural areas and 0.242 in urban areas in 1993. Income inequality between rural and urban areas has been observed commonly to be significant. By comparing the difference in mean income between rural and urban areas from 1978 to 1994, Wang et

al. (1995) concluded that income inequality between urban and rural areas in China was showing an increasing trend.

A vast country, China consists of a number of regions. It is necessary, therefore, to investigate personal income distribution for each province. Because each province is a relatively independent and integrated economy, income levels and structures may differ from province to province. So far, research on this topic has yielded few systematic results. Zhu and Wen (1990) and Griffin et al. (1994) calculated the rural Gini coefficients in 1988 for each province. Their results did not show a systematic relationship between rural economic development and income inequality. Griffin, et al. (1994) calculated the urban Gini coefficients for ten provinces. They found a similar conclusion as for rural inequality. In addition, they concluded that income inequality in urban areas is in general lower than income inequality in rural areas within provinces. Very little work has been done on measuring the income inequality between provinces. The work of Griffin et al. (1994) yielded no explicit result. Economic development is unbalanced in China; the east coast is developed, the middle of the country less developed, and the western part under developed. Yang (1992) used the Mean deviation to calculate the income inequality within and between the three parts. He concluded that the eastern part had the highest inequality, the western part the second highest, and the middle part the lowest. Also, the income in the eastern part was significantly different from the income in the middle and western part, while the income difference between the middle and west was small. Wei's (1992) research, based on a weighted mean deviation, yielded similar conclusions.

The methods often adopted in studying income inequality in China are the following: comparing the income means, calculating the mean deviation and computing the Gini coefficients. Although the Gini coefficient is popular, the other two methods have been disqualified for measuring income inequality. The results obtained by these disqualified methods are not trustworthy. Moreover, Gini coefficient also has the limit in decomposing the inequality. Thus far, Theil's index, also one of the qualified methods, has not yet been applied widely to measure income inequality in China.

Chapter 4 measures income inequality by Theil's index, and presents the results in a systematic way, looking at income inequality in its three aspects together: namely, the inequality between social classes, the inequality between rural and urban areas, and the inequality between provinces. First of all, the research calculates the overall inequality in China, and decomposes it into three components: the overall inequality between social classes, between rural and urban areas, and between provinces. Conse-

quently, the research takes account of the part played by each component inequalities in relation to the overall inequality. This chapter, secondly, calculates Theil's inequality in rural areas and in urban areas, separately. The inequality in either area is decomposed into the inequality between provinces and the inequality between social classes. The results reveal which area has higher inequality than another, and how much each inequality between provinces and the inequality between social classes contributes to the total inequality in each of the areas. Third, this chapter explores the inequality in each province, which is decomposed into the inequality between rural and urban areas and the inequality between social classes within the province. This result will reveal the ranking of inequality among provinces. Finally, the results in this chapter specify with the same detail all the inequalities between social classes.

To calculate Theil's index, certain data are required. In principle, two sets of information are needed: the data on the population classified with respect to three dimensions (provinces, rural and urban areas, and social classes), and the data on the income corresponding to the population categories. In total, there are 30 provinces, two areas, and eight social classes. The social classes are divided according to income sources and labor skills: the income earner includes unskilled, skilled, technician, manager, capitalist and self-employed, retiree, and income dependant. The data are detailed so as to assign each individual to a certain lot that is finally formed through the triple classifications of areas, provinces and classes.

This research constructs a large scale model to simulate the competitive market in China. The main part of the model is a linear program, in which market forces will automatically drive the economy to use its resources efficiently. However, the problem of resource allocation in this case is a bit complex because of the great amount of activities, commodities and resources. Chapter 5, therefore, serves as an illustration to the model. In Chapter 5, linear programming is briefly introduced as regards the model.

Departing from the classical Ricardian theory, neo-classical economists have made considerable progress by the introduction of the marginal productivity theory. In competitive markets, given a constant or decreasing returns to scale technology, competition may yield an equilibrium in which all the production factors are paid by the marginal products, and the price ratios between factors correspond to the slopes of the isoquant at the point determined by the factor endowments. Neo-classical theory has become one of the most attractive theories in modern economics, not only because it provides a great insight into competitive economies and the determination of

income, but also because it permits numerical solving. There have been some efforts towards modelling a competitive economy in some countries and, especially, towards accounting for factor prices. Explorations made in this direction, however, have not been widely recognized so far. A possible explanation is that most of the existing models have not yet reached a sufficient level of competency in the description of a competitive economy. In general, the more detailed the model, the more complex it becomes, and the more it calls for better techniques and more information. This problem has been motivating economists to search for more efficient and advanced modelling methods. Recently, ten Raa (1995) proposed a series of theoretical models and some empirics. In his work, factor prices are determined endogenously.

The present research is a new application of ten Raa's fashion of modelling. In Chapter 6, a general equilibrium model is constructed to simulate the competitive Chinese market. This model captures the internal forces determining income. The essence of an economic determination of personal income is to consider income generation and distribution in an economic system in which production, distribution and consumption flow interactively. Production generates income, and income distribution determines consumption, which in turn creates demand for production. Being static, the model is suitable only for the first part of the cycle: income generation from a production process. The model simulates the competitive market and solves the benchmark primary income distribution in the following way. Given initial endowments of production factors, constant or decreasing returns to scale technologies and fixed preferences (by maximizing the domestic final use), the economy reaches an efficient stage in which inefficient sectors are eliminated and resources are allocated optimally. In the model, production takes place according to Leontief's technologies, preferences are determined by the observed composition of domestic final uses, and the endowments consist of labor and capital only. Primary income consists of labor income and capital income which, according to neo-classical theory, are paid by the marginal productivity.

The model considers China as an economy integrated by her provincial economies. Competition takes place between sectors and provinces. Moreover, trade is free within the country. The model consists of a linear program and additional non-linear equations. The linear program comprises a pair of programs, which are called a 'primal' and a 'dual' programs. The primal program of the linear program shows production relationships, while its dual program reveals the aspect of cost relationships. The non-linear equation system is intended to control equilibrium in the place where overall

value of net exports of each province must match the observed value. By using linear programming and the Newton method for non-linear equations, the model solves the endogenous variables simultaneously. Solving the model provides the following results: domestic final use, provincial final uses, levels of sector activities, capital and labor employment, labor substitution and migration, interprovincial trade patterns, prices of tradable and non-tradable commodities, wage rates, and rental rates.

The final product, or net output, is the surplus of gross product minus intermediate uses. In an open economy, the final product includes the domestic final uses and the net export. Maximizing overall domestic final products can be considered as a goal of an economy like China. In the model, net exports to the rest of the world is considered to be an external resource; the objective therefore becomes maximizing overall domestic final use.

The economy has two endowments: labor and capital. Labor is classified into four types: unskilled, skilled, manager and technician, according to occupation. The types are substitutable from technician to manager, skilled, and to unskilled. Technician, manager and skilled labor are mobile between sectors within each province, while unskilled labor is mobile across all sectors and provinces. Capital is completely immobile and specific in each sector in each province. Household preferences are considered to include the observed composition of domestic final uses. Production involves the inputs of labor, capital and intermediate commodities and services. There are 30 types of commodities and services, among which 29 are tradable, and one is non-tradable. Technology determines the composition of inputs in sectors, which is detailed in the input-output table by province.

Chapter 7 has three tasks: to outline the competitive markets, to transform functional to personal income distribution, and to measure income inequality. After the model is solved empirically, the competitive Chinese markets are exposed. In the markets, competition eliminates the most inefficient activities, restricts the less inefficient activities, and encourages the efficient activities. As a result, resources are allocated optimally, thus removing inefficiency in the observed economy. Because labor is employed fully in the observed markets and trade to the rest of the world is fixed in the model, the inefficiency is in fact the allocative inefficiency. In the competitive markets, skilled labor and highly skilled labor are no longer fully employed, as unskilled labor is a mobile factor within the nation and skilled and highly skilled labor are mobile factors only within a given province. As some inefficient sectors are cut back or closed down, unskilled labor flows into the expanded sectors, but skilled

and highly skilled labor cannot follow. In the competitive markets, because of the efficient employment, resources are valued by the marginal productivity. Therefore, functional income is revealed. The most important information from the results is about the rental and wage rates that equal the marginal productivity. As the rental rate and employment of capital are known, capital income is obtained by multiplying the rental rates with the employed capital. The unskilled wage is solved directly in the model, but the wages of the skilled and the highly skilled are obtained by summing the unskilled wage and the wage premiums of skilled and highly skilled labor that are solved together with the unskilled wage in the model. The way to calculate the wages of skilled and highly skilled labor is as follows:

The wage of skilled labor is the sum of the premium and the wage of the unskilled,

The manager's wage is the sum of the premium and the wage of the skilled,

The technician's wage is the sum of the premium and manager's wage.

Once functional income distribution is solved, personal income distribution can also be solved, if capital ownership data are given. In practice, it is almost impossible to specify capital ownership at the individual level, because of the wide variety of capital types and the lack of the information on capital holders. To overcome the problem, this research separates capital into government and private capital, and assumes that the capitalist is the sole earner of private capital income. The capitalist's income is calculated according to the proportions of private capital in total capital within the sectors. Per capita income of capitalists is calculated by dividing capitalists' income over their number.

In competitive markets, the self-employed are no longer considered to be a special class; they earn as same as skilled labor. The class of retirees is assumed to earn an average of the wages of the technician, the manager, skilled labor and unskilled labor. The income of dependants, which is accounted for based on the assumption that dependants share their income with money-earners within family, is obtained by dividing the mean income of primary income earners over the dependency ratio.

After the personal income distribution (which is reflected by the data on the classified population and corresponding income) in the competitive markets is made known, the extended form of Theil's index is applied to measure income inequality. The information structure regarding the income inequality in this chapter is the same as in Chapter 4, so that the income inequality in the current and the competitive markets can be compared to each other.

1.3 Conclusion

This research explores what a market economy will do to personal income distribution in China. More specifically, it has completed the following tasks: developing a theoretical basis of the personal income distribution determined by internal economic forces, constructing a computable general equilibrium model to simulate the hypothetical market economy in China, solving the model and revealing the functional income distribution, connecting the functional to the personal income distribution, measuring the income inequalities in both the observed and the competitive markets, and drawing conclusions.

The most important result from the research is the revelation of both observed and hypothetical, competitive distributions of personal income. From the current to the market economy, personal income distribution will change considerably. In particular, the income inequality between social classes will grow. This is because there are an abundance of unskilled and a scarcity of highly skilled labor in China; skilled labor will be rewarded much more than unskilled labor when work is rewarded according to marginal productivity. As a result of competition, technician, manager and capitalist will gain, while the unskilled and the self-employed will loose. The income inequalities between areas and provinces will also increase, even though their shares in the overall income inequality will decrease. This result is caused mainly by the migration of unskilled labor. Competition would dissolve the negative relationship between the level of economic development and of income inequality across provinces. Among the areas, the urban areas will be the winners in all provinces, but rural areas will be the relatively small winners in nine provinces, the big winners in six provinces, and the losers in twelve provinces. Among the eastern, the middle, and the western parts, the eastern part will be the big winner, because in the eastern part, income will increase in all the ten provinces; in the middle part, Anhui and Sanxi will be the big winners, and Jiangxi and Henan will be the losers; in the western part, Gansu, Xinjiang, Ningxia and Yunnan will be the big winners, and Guangxi and Guizhou will be the losers.

In spite of its achievements, this research still faces some limitations that will need to be addressed in future studies. With respect to the modelling, the objective in the model is only a part of the final product, because the model assumes the net export outside of China to be fixed. A potential improvement is to incorporate the net export outside of China into the objective, and then to consider the role of the world economy in the model. The model has a strong assumption that fixed capital

is sector specific. In fact, some fixed capital is sector specific, but some is not. If the fixed capital is divided into the specific and common fixed capital, and the model allows the common fixed capital to be mobile among sectors and even locations, the results will be improved. Also, the model has another inappropriate assumption that the technician is mobile among sectors. In fact, the technician may be of two types: the special and the general technician. A special technician is unable to move to other sectors, while a general technician does. The model has a deadly drawback that, owing to the linear program in the model, the number of non-zero shadow prices inevitably is influenced by the number of independent constraints in the linear program. In other words, the fewer independent constraints, the more zero shadow prices. To avoid the problem, the model may have to consider the modelling of a non-linear program rather than a linear program. Finally, for the research on personal income distribution, the model does not directly include personal income distribution. It merely generates functional income distribution and leaves the personal income distribution to be dealt with outside of the model. In most of the studies on income distribution policy (such as that of Adelman-Robinson (1978) and Sahota-Rocca (1985)), the loop of personal income distribution is presented in the model in order to capture the feedback effects of personal income distribution on policy. If the model in this research wants to say more about transfer income distribution, then it must directly incorporate the loop of personal income distribution.

With respect to the empirics, the problem of data availability inevitably hurts the results. The data on capital utilization, in fact, do not exist. The empirical analysis has no choice but to substitute the capital for production for the capital utilization in industrial sectors, despite the fact that two differ considerably, at least in their definitions. More roughly, the empirics have to use the industrial data to estimate the capital utilization rates in the sectors of agriculture, commerce, construction, finance and banking, education, and public administration. Because unemployment in the current Chinese markets is not well observed, the empirics have to assume that labor is employed fully in the current markets, even though this, in fact, is not true. It is also unrealistic to assume that the capitalist is the sole earner of capital income. Apparently, other classes of people may also hold a certain amount of private capital, and earn the income. However, collecting the data on this aspect is beyond of the ability of the present research. An additional restriction of this research is that it was unable to reveal the levels of the overall income inequality, since it ignored within-class inequalities. If the research could include micro-data to investigate the within-class

income inequalities, the results would certainly be improved.

Chapter 2

Concepts, Theories and Applications

2.1 Introduction

Income distribution is a problem that everyone thinks about. Why do people earn differently? Is it fair? To whom should I compare my income? Economists ask even deeper questions: What income status does a particular earner occupy? To what extent and why do the income differences exist? Is the difference rigid or flexible? The accumulated knowledge on income distribution is plentiful. It has encouraged and assisted further studies. Yet, the theory is incomplete and controversial. This chapter attempts to clarify some basic concepts, to summarize existing theories, and to review recent applications. Without a careful specification of the theoretical structure, further study on income distribution is unlikely to be helpful but may rather cause confusion.

Section 2 deals with some income concepts such as the definition of income, income sources and uses, distribution processes, income recipient units, etc..[1] Essential issues in the section are the definitions of 'person' and 'personal final income'. 'Person' refers to an individual in this research. Theoretically, income is defined as the sum of the market value of rights exercised in consumption and the change in the value of the store of property rights between the beginning and end of a certain period.[2] Practically, final income is formed by three income flows: primary, transfer, and family

[1] This kind of research has been studied delicately by A.B. Atkinson (1983).
[2] Simons(1938).

income flow. In the primary stage, labor, private and public capital participate in production, the production sector releases income, and labor, private capital owners and public sectors are all recipients of primary income. After the primary income flow, the public sectors distribute primary income further; it acts as both income receiver and releaser. The income that flows in and out of the public sector constitutes the second flow. During or after the second flow, income is distributed further within the family. This is the family income flow. Final income is formed after income has gone through all three flows.

Section 3 reviews the recent theory of income distribution in order to give the research a strong foundation on the most recent insights. Research on income distribution has traditionally been developed into two branches: the functional and the personal income distribution. The former is concerned with income distribution among production factors. It seeks to explain prices of production factors – land, labor, and capital. The latter, also called the size distribution of income, studies income distribution among persons. It shows particular interest in explaining personal income differences. Historically, functional income distribution theory has been well developed through the efforts of classical and neo-classical economists. In comparison, less progress has been made on the theory of personal income distribution. For a long time, this theory has consisted mainly of a statistical approach to individual characteristics, which is basically isolated from the economic structure and therefore provides few insights on economic intuition. Gathering speed recently is the trend to combine these two branches in order to analyze personal income distribution in depth and comprehensively. In the modern theory of functional income distribution, neoclassical theory is particularly attractive for applications, as it allows for numerical calculations. According to the theory, functional income distribution is closely linked with the distribution of personal primary income. Namely under perfect competition, the marginal productivity of resources determines resource prices. Once the prices of resources are known, personal primary income becomes traceable.

Many recent applications have studied the incorporation of personal income distribution into economic models. Section 4 reviews the other applications, focussing particular interest on comparing the model in this research with the Adelman-Robinson model.

Personal income distribution has been traditionally analyzed with econometric

models.[3] Such models are based on individual characteristics, and therefore are devoid of economic intuition. Their abilities to simulate economic forces, to explain outcomes, and to shed light on economic phenomena are limited. The absence of an economic model of personal income distribution is probably due to the fact that functional and personal income distribution have been considered as two separate regimes. It was not until the early 1980's that some work approaching the issue of personal income distribution as a component of an entire economic system, attempting to integrate it with functional distribution, appeared. Then, research on generation and distribution of personal income entered a new stage. At that stage, the research relied mainly on neo-classical theory. The experiments usually construct a general equilibrium framework in which functional and personal income distributions are connected, and then apply the model to developing economies. Among such studies are Adelman and Robinson's (1978) application to Korea, the BACHUE model of the Philippines (1977), Taylor and Lysy's (1980) application to Brazil, Ahluwalia's (1974) application to Malaysia, and Sahota's (1985) application to Brazil. Although their work has much in common in theory and methodology, they differ with respect to the problems they address, the information available, and the economies studied. In particular, the Adelman-Robinson model has been commonly recognized as one of the most comprehensive existing models on personal income distribution.

The Adelman-Robinson model has much in common with the model in this research applied to the Chinese economy. First, both models are based on neo-classical theory. Second, both models set up a static core model of computable general equilibrium to generate factor income from the production process. Third, both models are multisectoral. Fourth, both models divide labor and households into several classes, according to certain criteria, to transform income from functions to persons.

The model in this research differs from the Adelman-Robinson model, however, in the following aspects. First, the model in this research attempts to reveal a benchmark income distribution of persons in competitive markets rather than to simulate or optimize policy concerns. Second, the model in this research is built on the basis of economic fundamentals only and therefore requires a minimum set of information compared with the Adelman-Robison model and others. Third, the model in this research combines linear programming with non-linear equations, while the Adelman-Robinson model and most of the other applications are non-linear. Fourth, the model

[3]See, for instance, Tinbergen (1975).

in this research is multiregional and solved completely and successfully, while the Adelman-Robinson and other applications usually work on one economy. Fifth, the model in this research does not include personal income distribution directly, but the other applications all incorporate it directly in their models.

2.2 Income concepts

2.2.1 Definition of income

Although classical economists have suggested various definitions on income, Simons' comprehensive definition of income is accepted by most economists nowadays. Simons (1938) defined income as the sum of the market value of rights exercised in consumption and the change in the value of the store of property rights between the beginning and end of a certain period. It should be noted, therefore, that income was in general not identical to consumption during a period, unless the property value during that period is constant. Personal income is used normally for consumption, saving, investment, taxes and bequests. Consumption is the income expenditure on goods and services. One may also use part of income to increase wealth by saving or investing. Taxes are the payments to the government or public sectors. Bequests are the opposite of inheritances, namely the income that one gives to others.

The above definition approaches income from its uses. However, income is observed, in practice, more often from its sources. Basically, personal income has four sources. The main source for labor is earnings, which include all kinds of salaries and wages. Rent, interest and dividends constitute the income source of capital holders. In general, 'rent' represents capital income. The third source is transfer income, which has many forms, such as pensions, unemployment subsidies, medical care, life insurance, housing allowances, education subsidies, and child support subsidies. All these kinds of transfer income can be represented briefly by the term 'subsidies', since government and public sectors pay them. The fourth source is family income, including the transfers of cash, savings, property, house, land, and goods and services within family. Usually, the term of 'inheritance' simply represents this source, because it is a transfer within the family.

Based on the sources, personal income distribution, in fact, includes three distribution procedures: primary, transfer and family income distribution. Since earnings and rent are determined by production, they constitute the primary income distribution,

which is in fact an 'economic distribution'. The source of subsidy is the tax collected from the primary income of labor and capital holders. In a sense, it is a redistribution of primary income. This distribution is called a transfer income distribution. Subsidy is distributed by government and public sectors, and therefore depends on government and public sector policies. For this reason, it is in fact a 'policy distribution'. The remaining income is disposable, and will be distributed further within the family. This is the 'family distribution', which may take place before the transfer distribution. One example is the inheritance tax levied upon inheritance. One may argue that there is also inheritance between families. However, because inter-family inheritance is relatively negligible, it is usually ignored.

The income that remains after the three distributions is the final income, which is used for consuming and for increasing property. Final income is a proper definition to measure income inequality. Diagram 2.1 illustrates the procedure of income formation.

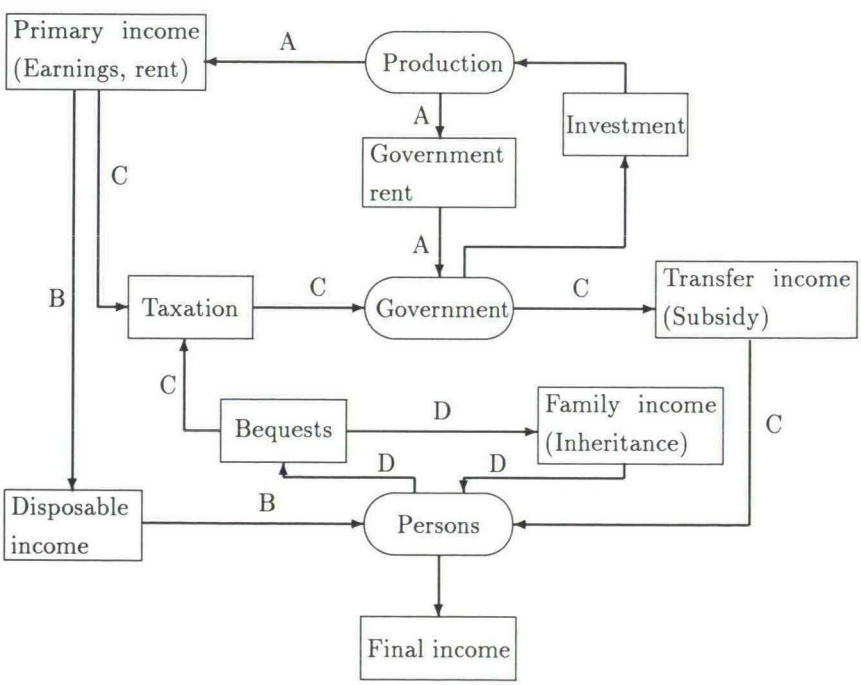


Diagram 2.1. The procedure of income formation

A arrows – functional income distribution

B arrows – primary income distribution

C arrows – transfer income distribution

D arrows – family income distribution

The diagram presents income sources and uses around production, government or public sectors, and persons. Arrows with A indicate the functional income distribution, where labor and personal capital gains are extracted from production to form the primary income of labor and capital owners. At the same time, because the government may own some capital, production then also distributes the capital gains to government. The government rents are used either as transfer income to persons or as investment in production.

The B arrows represent the primary income distribution. Primary income becomes disposable income after tax, and then goes to the labor and capital owners. C arrows show the transfer income distribution, where government is the principal. Taxes on primary income and bequests constitute another source of government income. Except for the investment part, the remaining government income is a transfer (subsidy). The subsidy to persons constitutes the transfer distribution. Finally, D arrows illustrate the distribution among persons within the family. Income given by one person to another is a bequest, while income that one person receives from another is an inheritance. As a result, everyone obtains a final income, which is used for consumption or for the stock of property.

2.2.2 Recipient unit and classification

With respect to personal income distribution, the income recipient units are persons. Defining a person, however, is not as easy as defining income. There are three alternative descriptions of a person: a household, a family and an individual. Since Debreu (1959), the household unit has become a popular economic unit for analysis. A household may be an individual, a family, or a group of people who live together and share some common uses. The advantage of this concept is that it can reveal market potential. However, it may prove unsuitable for research on personal income distribution, because different households may be composed differently. For instance, while one household may be an individual, another household may be a group of people. Due to different sizes, income between the two households is incomparable. Smeeding and Gottschalk (1995) point out that although the household unit captures the economies of scale associated with shared living arrangements, it assumed a degree

of income sharing within the household that might not be realized.

On the other hand, the family as an economic unit has been used extensively in the analysis of personal income distribution. A family is often limited to a nuclear family that consists of a couple and their children rather than also their parents and other relatives. Atkinson (1974) proposed that the nuclear family should be the natural unit for personal income analysis, since by convention children obtained a large income from the working parents, and wives who did not go out to work shared income with their working husbands, or men who did not work shared income with their working wives. In other words, his adoption of the nuclear family unit is based on the premise that income is identical within the nuclear family. Atkinson (1983) further consolidated the nuclear family concept in his study of Sweden. In that case, income distribution on the individual level could not be determined because a large part of the individuals had very little income and also because of the little information available on intra-family transfers. These arguments cannot be followed directly, however. By assuming identical distributions among families, the ambiguity problems associated with intra-family income transfers can be removed, and income on the individual level then becomes traceable. There is thus no reason to restrict analysis to the family level. Atkinson's second argument is that individual income does not represent the distribution in general because children and non-working people have very little income. Here, he takes account only of individuals' primary or secondary incomes rather than their final incomes. Since children and non-working people actually share income with the working people within their family, individuals' final incomes are comparable.

In the opinion of this research and many other sources,[4] the individual is the best among the three potential units, particularly because it is the only one able to reveal income distribution among persons rather than among groups or families. This research adopts the individual as the basic unit of analysis because the population can be classified precisely at individual level. In general, personal income differences are observed between the social classes. The study on personal income distribution, therefore, always needs to classify individuals into various social classes. The classification may be done by persons' education levels, occupations, employed status, economic status, social identifications, ages, sex, etc.. Every individual belongs to a specific class. As this research is interested in showing how income generates from a

[4]For instance, Sutherland (1995), and Smeeding and Gottschalk (1995).

source, how that income flows from person to person, and finally how that income causes differences between persons, it is desirable to classify persons by income source into primary, transfer and family income receivers.

The primary income earners consist of wage earners and rent collectors. Typically, the wage earner is the laborer, which can be further categorized by skill. There may be many skills, but this research summarizes them into four categories: the unskilled, the skilled, the higher skilled, and the highest skilled. Correspondingly, labor's categories are the unskilled, the skilled, the manager and the technician, respectively. If laborers are paid based on skills, wages will cause income differences between the labor classes.

Typically, the rent collector is the capital owner, to classify whom the capital amount may be considered as a primary criteria. Yet, this classification alone is insufficient to reveal the difference in capital income among capital owners, because capital consists of many types and each type may have different return rates. Therefore, it is also necessary to classify the capital owner by capital type. Only when both classifications are used can the difference in capital income be revealed. In practice, capital ownership, particularly regarding the capital types, is rather difficult to ascertain, because not only the capitalist but also labor or other individuals may hold some amount of capital, and the compositions of the capital are basically in hands not observable. However, in a developing economy like China, this problem is relatively less serious. In China, only the capitalist, in fact, holds a significant amount of private capital; labor and other individuals usually do not. Following other research on developing countries,[5] this research simply assumes that the capitalist is the sole owner of private capital.

Besides labor and the capitalist, there exists an additional class of primary income earner, called the self-employed. The income of this class, in fact, is a mixture of wages and rent. Adelman and Robinson (1978) defined it as the net value-added, which consisted of the self-employed wage and the residual rent after payments to all other factors. In my research, the self-employed does not earn any special wage than the wage of labor. Rather, the wage of the self-employed should be determined by the skill of the self-employed. Because with competition all wages of labor correspond to certain levels of skill, the self-employed wage should match the skill level that they reach. For example, if the self-employed person was a skilled worker, his business income generated from the work that he is currently doing as self-employed should

[5]For instance, Taylor and Lysy et al. (1980).

not be less than a skilled wage – otherwise he would continue his job as a skilled worker. Under perfect competition, the self-employed business income might exceed that of the skilled worker – not because he receives a manager's wage, but rather because the part over the wage comes from the rent generated from the capital owned by the self-employed.

In general, the recipients of transfer income cover a broad range. Many individuals receive transfer income through various forms of subsidy. The transfer program, however, is very limited in China, where the government has not widely applied public security programs. It seems that only retirees are fully supported by the government.[6] Other groups of individuals have to rely on their families, and are therefore the recipients of family income, or called the dependants. Unemployed persons in urban areas rely on family rather than on transfer income. Urban unemployment is small. Most of the unemployed just temporarily depend on family while looking forward to job opportunity; the rest of them may get an allowance from the government while working for the government in some public works project. The amount of the government allowance is usually too small for a living, and such unemployed persons usually have to depend on family. It has been calculated that in 1994 the average amount of the allowance distributed to the applicants is 21.5 Yuan per month per person only, which is 0.48% of the average wage at that same time.[7] For this reason, the unemployed person is considered (for our purposes) to depend on family income rather than on transfer income. As is the case of unemployment, very little income is transfered through government or public sectors to students and those with disabilities. Few students, for example, receive subsidies for study, and disabled persons are granted a limited subsidy only.

In contrast with the recipient of transfer income, many people depend on family income. These people, who are called dependants, include minors under the age of 15, students above the age of 15, urban unemployment, housework, and disabilities.

In total, this research categorizes the population into eight classes: the unskilled, the skilled, the manager, the technician, the capitalist, the self-employed, the retiree, and the dependant. Among the primary income earners, the classes of the unskilled,

[6] In fact, via firms.

[7] According to Table 8-15 in the 1995 China Labour Statistical Yearbook, with a 2.8% unemployment rate in urban area in China in the year 1994, there are 4.764 millions of urban unemployed persons, 41% (=1964/4764) of them have been granted an unemployment allowance in total amount of 507,552 thousands Chinese Yuan, which accounts for some 0.074% of total staff and worker's income.

the skilled, the manager and the technician earn wages, capitalists earn private-capital income, and the self-employed earn both wage and private-capital income. The retirees receive transfer income. In addition to the classification of the population into social classes, the population must be classified by rural and urban area and by province. The final data should be detailed to such an extent that each individual is allocated to a certain class which is formed through a triple classification of social classes, areas, and provinces. For example, a manager in an urban area in Beijing, and a child in a rural area in Gansu province.

2.3 Survey of existing theory

2.3.1 On income generation

Income generation lies at the foundation of the functional distribution of income. Johnson (1973) summarized classical and neo-classical economists' debates on this topic. Because income generation is the origin of also personal income formation, this research reviews part of theory of functional income distribution, based on Johnson (1973).

Among the classical economists, Ricardo[8] can be recognized as the founder of income distribution analysis. His analysis features three production factors: land, labor and capital. Among these, land and labor are direct production factors. Capital, necessary for the use of labor during the production process, is an indirect production factor. National dividends are attributed to the sum of rents to land, the wages of labor, and the profits to capital. Assuming national output is fixed and there is no rent (in other words, national output is the margin of production on land), rent is the residual of total output and the cost of labor and capital. By applying the Malthusian law of wages that a population breeds to the level of subsistence, the subsistence wage rate becomes fixed. Then, the excess of marginal product of labor over the cost of labor is the second residual that is contributed to profits.

A notable feature of Ricardian theory is its stress on the role of land rather than capital. This emphasis on land originated from the economic situation of that period (19th century), in which agriculture was the dominating sector of the national economy, and capital was recognized as a stock of food only. Wicksteed[9] extended the

[8]See Johnson (1973), for reference
[9]See Johnson (1973), for reference

theory by noticing that any of the three factors could be regarded either as marginal product or as surplus, because Ricardo's definition of residuals is purely arbitrary.

A problem arising from Wicksteed's generalization of the marginal productivity of all factors is whether the incomes determined by marginal productivity would exhaust the product exactly. This problem is solved subsequently by Hicks and Samuelson[10]. They argue that perfect competition is a sufficient condition for incomes to exhaust the product. Since factors are paid according to their marginal productivity, and perfect competition induces zero profits in the case of constant returns to scale, firms in equilibrium choose production at a level where both requirements are fulfilled. Denoting commodity price and quantity by p and X, and factor price and quantity by ω and q, respectively, the competitive condition is:

$$pX = \sum \omega q,$$

and the marginal productivity of factor condition is:

$$\omega = p\frac{\partial X}{\partial q}.$$

Hence,

$$X = \sum \frac{\partial X}{\partial q} q$$

The classical Ricardian theory on income categories such as rent, wages and profits has been developed further by Marshall[11] for two aspects. First, he discards the special role of the rent of land and proposes that each of the specific factors used in the production process may get a 'quasi-rent', since they may be in fixed supply – at least temporarily. Second, he makes a distinction between the concept of profits and the concept of interest, which are identical in classical theory. Fisher[12] provides a comprehensive explanation of interest. He explains income as a stream of contributions to outputs yielded by some source. Capital is the value of that source, determined by capitalizing the value of the stream of productive contributions by means of the current rate of interest. Interest is the relation between income flows and the capital values of the resources. Anything that yields a contribution to some output is capital and has a capital value.' In other words, interest is considered to be capital income,

[10]See Johnson (1973), for reference
[11]See Johnson (1973), for reference
[12]See Johnson (1973), for reference

whereas profit is a surplus of the reward earned on past investment in relation to the contractual costs associated with that investment. To summarize, the generalization of classical income categories is presented in the below diagram, borrowed from Johnson (1973):

	Necessary payment	Surplus or deficiency
Current income receipt	WAGES	RENT (always non-negative)
Current income receipts related to past investment	INTEREST	PROFIT (may be negative)

Diagram: Classical Categories of Income

2.3.2 On the nature of income differences

The cause of income differences is one of the two main components of the theory of personal income distribution. Sahota (1978) provides a comprehensive survey on theories of personal income distribution.

According to the functional income distribution theory, income is generated, from an economic point of view in a production process, and income differences result from the differences in marginal productivity of production factors. Early statisticians and economists working on personal income distribution were not aware of this, or did not pay attention to this, however. Instead, some of them tried to approach income differences from preordained forces, whereas others, instead of relying on human or social forces, explained the causes of income differences or marginal productivity only partially. To obtain insight into past and contemporary theories of personal income distribution, this research reviews them once again from the viewpoint of final income, which consists of primary, transfer and family income.

Approaches to final income differences

The early economists did not explicitly divide personal income into the three categories of primary, transfer and family incomes. Rather, they examined only the distribution of final income. Well-known approaches were the stochastic approach and the individual choice approach.

The stochastic approach is one of the oldest. It originated in the late nineteenth century and thrived in the first half of the twentieth century. Gibrat and Champernowne are the important contributors. The theory supposes that personal income is determined by 'windfall' and that income distribution is a random process. It predicts that, no matter what the initial distribution is, due to stochastic forces, the process converges to an equilibrium at which the income distribution is close to a Pareto type distribution.

Gibrat[13] discovered that the distribution of logarithms of some economic variable was approximately normal, and also conjectured that the distribution of logarithms of incomes obeyed the Gaussian law that the logarithms of the income was the result of a large number of small causes of which, the proportional effects upon income were independent of the magnitude of other causes. In this context, Champernowne (1937) argued, however, that the proportional effects of small causes acting upon income were not independent of one another. Instead, he assumed that the proportional effects of economic influences on groups of incomes depended largely on the size of the incomes in the group. Champernowne (1953) concluded that income distribution fluctuated in the short run, and was in equilibrium in the long term. It seems that the stochastic approach has reached a dead end, since contemporary economic theories have stated that income distributions are influenced by systematic forces rather than windfall forces.

Friedman (1953) proposed an individual choice theory, which stated that personal income differences resulted from not only uncontrollable circumstances such as windfall, endowment and inheritance, but also from collective action such as taxation and subsidies. In particular, the theory focuses on the effect of individual choice on income differences. There are two ways in which individual choice may affect income distribution. First, compensation for non-pecuniary advantages or disadvantages causes money income difference in order to equalize real income. Second, differences in individual's tastes for risk cause disparities in income distributions. Individual choice theory is partial, since it explains only part of these income differences – most of which are attributed actually to the differences in endowments.

[13]Referring to Kalecki, M. (1945)

Approaches to primary income differences

Theories explaining primary income include, for instance, ability, human capital, educational, and life-cycle theory. One of the early approaches to personal income distribution, ability theory, originated in the middle of the nineteenth century, and attributed earning differences to ability differences. It presumes the distribution of abilities to be normal – just as the distribution of various physical traits, such as weight and height of the human body, and furthermore infers the income distribution to be same as the ability distribution. However, this inference was repudiated by Pareto in 1897; he found empirically that income was distributed lognormally rather than normally. Since then, ability theory has been conducted to explain the inconsistency between income and ability distributions. Among contemporary theories of personal income distribution, ability theory has become less attractive. Because ability itself is an ambiguous concept and therefore is indefinable and immeasurable, the relationships between ability and income are not yet revealed explicitly.

Life-cycle theory is a partial theory considering earning distributions. It considers that the point-in-time income differences are overestimated and seeks the explanation of income difference corresponding to one's age and the distinction between life-cycle income and point-in-time income. Modigliani and Ando (1960) observed that life-cycle earnings roughly conformed to an inverted parabola. However, there are doubts about the actual role of the age effect on income distribution for at least two reasons. First, the age effect is relatively negligible, especially when factors such as schooling and on-the-job training are split from mere age or sheer experience. Second, according to Atkinson's experiments, a large part of income inequality in Britain is within rather than between age groups.

Approaches to transfer income differences

A theory explaining transfer income is the public income redistribution theory, which deals with two issues: the distribution of tax burdens and the distribution of public expenditure benefits. The theory of tax incidence, which has been well formed in public finance theories, explores the relationships between tax schedules and tax burdens. Taxes are categorized into, for example, personal income, excise, gift, estate and death, general sale, custom and duty, corporate income, and property, while tax burdens are distinguished into taxpayers, consumers, purchasers, households, earners, and owners. The distributive effects of various taxes on burdens, therefore, constitute

the content of tax incidence. Theories of tax incidence are reviewed by Musgrave (1974, 1985).

While the theories of tax incidence are well developed, the theories of the distribution of public expenditure benefits have not been developed to a sufficient extent. Public expenditure includes transfer payments and publicly provided goods and services. The distribution of public transfer payments is straightforward, whereas the distribution of benefits of publicly provided goods and services is difficult to be specified, because some public services are such that the resulting benefits may be imputed to particular individuals or groups. Musgrave (1974) did some hypothetical analysis on this subject, but no general theories exist.

Approaches to family income differences

The examination of family income transfers is based on inheritance theory. Inheritance has been frequently considered the same as material inheritance. There are arguments, however, that inheritance should also include genetic and cultural inheritance. Most research, however, has to do with material inheritance.

2.3.3 Theoretical structure in this research

Although there exist various theories on personal income distribution, all of them are partial; the theories complement each other. This problem has lured contemporary economists into a search for a comprehensive theory on personal income distribution. This research on China, however, is not intended to do so. Instead, the research is intended to explain personal income distribution from the point of view of economics. The economic theory on personal income distribution states that economic fundamentals of endowments, technologies and preferences determine functional income distribution, which is closely linked to the distribution of personal primary income. Information provided on ownership of endowments, on transfer programs, and on family composition can reveal the nature of primary, transfer, family and therefore final income distributions.

While the study applies the neo-classical theory on functional income distribution, the theoretical structure of this study also embodies most contents of the theories on personal income distribution. However, for the sake of experiment, these theories are simplified in the research. As this research does not consider stochastic forces to explain personal income, the stochastic theory is not applied in the research. Human

capital theory has remained popular in recent studies. The model in this research combines this theory with education, ability, and inheritance theories, for in the model all these factors are represented implicitly by the difference in labor productivity. The theoretical structure does consider public income distribution theory, but confines it to only a certain type of subsidy (such as pensions). This research also applies inheritance theory, of which only material inheritance is considered.

2.4 The applications

2.4.1 The Adelman-Robinson model

The purpose of Adelman and Robinson's (1978) application was to simulate the effect of various economic policies on personal income distribution. As they expected, an evaluation of political impacts should be done within an economic system able to trace out both direct and indirect influences on personal income, to capture the multiple impacts of various policy programs, to assess the ultimate consequences of current decisions, to facilitate comparisons between alternative programs, and, in general, to allow for intelligent and informed policy designs.

The model has dynamic features. It consists of a static, Johansen (1960) fashion, within-period adjustment model linked to a dynamic, intertemporal-adjustment model. Within each period, the static model adjusts towards general equilibrium under various constraints such as capital stock and labor force, technology, and government interventions. Between periods, some constraints are adjusted in response to changes in capital accumulation, population growth, migration, and production structure.

Although the overall model is dynamic, its static part is more interesting to my research. The static model is built mainly on the neo-classical theory of the functional income distribution. Production is assumed to be a function of resources such as labor and fixed capital, and of intermediate resources. The production function with respect to labor and fixed capital is assumed to be neo-classical, allowing for factor substitution.

Denoting

λ – resources, $\lambda = 1, ..., m$,

i – sectors, $i = 1, ..., n$,

R – input,

X – output,

the production functions with respect to resources are as follows:

$$X_i = f_i(R_{i1}, ..., R_{i\lambda}).$$

Let V represent the intermediate output, let j identify commodities, and let A_{ji} be intermediate coefficient, then the intermediate goods required are given by

$$V_{ji} = A_{ji}X_i.$$

Firms maximize profits. In terms of the firm's behavior, the cost of intermediate goods is simply proportional to output, and net receipts are the sale price minus the fixed charge. Thus, denoting

p_i – the price of goods,

the net price of goods i can be defined as

$$p_i^* = p_i - \sum_j A_{ji}p_j,$$

In terms of hiring decisions for other factors, the firm views the net price as the marginal revenue from the sale of one more unit of output.

In factor markets, the first-order conditions for profit maximization require that firm i hire factors until the prices of resources equal marginal revenues. Denoting

ω_λ – the price of factor,

then

$$p_i^* \frac{\partial f_i}{\partial R_{i\lambda}} = \omega_\lambda.$$

The first-order conditions are solved by writing factor demands as a function of net prices, resource prices, and employment of other factors:

$$R_{i\lambda} = g_{i\lambda}(p_i^*; \omega_1, ..., \omega_m; R_{ik}, k = 1, ..., m, and, k \neq \lambda).$$

Denoting γ_λ as the total demands for the factors, the total demands for the factors are aggregated across sectors:

$$\gamma_\lambda^d = \sum_j R_{j\lambda}.$$

Assuming that the total supplies of factors, γ_λ^s, is exogenously given, then equilibrium in the factor market requires factor demands to be equal to factor supply, or, excess demand for factors to be equal to zero:

$$\gamma_\lambda^d - \gamma_\lambda^s = 0.$$

For given prices, the excess-demand function can be seen as a function of factor prices. The problem is then to find a set of factor prices that clears factor markets. These prices determine product supplies, and hence yield the goods supply as a function of prices.

With the demand side of the model, the functional income distribution is first calculated. Denoting y_λ as the aggregate income by factor λ, it is calculated as

$$y_\lambda = \sum_j \omega_\lambda R_{j\lambda}.$$

The model assumes that each factor type consists of a homogeneous group of people whose consumption behavior can be represented by an aggregate expenditure function. Denoting

$C_{i\lambda}$ – the demand for goods,

c – total demands for goods,

the demand $C_{i\lambda}$ for goods i in sector λ is a function of factor income and commodity prices:

$$C_{i\lambda} = h_{i\lambda}(y_\lambda; p_1, ..., p_n),$$

The total demand c_i^d for good i is:

$$c_i^d = \sum_\lambda C_{i\lambda}.$$

The good supply for final demand is determined by subtracting the demand for intermediate goods:

$$c_i^s = X_i - \sum_j A_{ij} X_j.$$

The equilibrium is reached in the product markets if excess demand for each good is zero:

$$c_i^d - c_i^s = 0$$

The market-clearing prices of both goods and factors are solved with the model that includes around 3,000 unknowns and equations. As this economic system consists

of non-linear equations, Adelman and Robinson use the following algorithm to solve it.

(1) start with an initial guess of commodity prices.

(2) solve the factor-market equations for factor prices, employment, and production.

(3) solve the product-market equations and calculate excess demands.

(4) raise or lower commodity prices in sectors where there are excess demands or supplies.

(5) normalize prices and start another iteration. Stop iterating when all excess demands equal zero.

General equilibrium modelling has been done intensively since Johansen (1960); the new part of the Adelman-Robinson static model is its extension to personal income distributions. To access the problem of income distribution between persons, the static model separates labor into the 15 categories below according to their occupations. The different types of income that are imputed to the different categories are listed on the right-hand side, where agricultural wages must be determined in the agricultural labor market only.

1. engineers ——— wage
2. technicians ——— wage
3. skilled labor ——— wage
4. apprentices ——— wage
5. unskilled labor ——— wage
6. white-collar workers ——— wage
7. government workers, including teachers and doctors — exogenous wage
8. self-employer 1 ——— net value-added
9. self-employer 2 ——— net value-added
10. capitalists ——— profit
11. landlord 1 ——— agriculture business income
12. landlord 2 ——— agriculture business income
13. landlord 3 ——— agriculture business income
14. landlord 4 ——— agriculture business income
15. landless labor ——— agriculture wage

The connections between the functional and the personal income distribution are done, first of all, by generating the income distribution of workers before taxes and transfers. Solving the equilibrium functional distribution reveals the mean income

and the number of each category of workers. To avoid further investigation of the income distribution of each category of workers, the model simply assumes each of the within-categories distribution of workers to have a lognormal form. Furthermore, the log variances of the first seven categories are estimated within the model, whereas the log variances of the rest of the categories are obtained exogenously.

Following the same procedure, the model determines the within-category distribution of workers' income after taxes and before transfers, and the within-category distribution of workers' income after taxes and after transfers. Here, direct taxes are calculated by applying the appropriate Korean tax schedules to each type of income. Using the size distribution function, average income recipients representing the mean incomes of successive twentieths of the distribution are constructed for each group of agents. The appropriate tax schedules are applied to the twenty average incomes in order to obtain the total group tax. The total group tax is then adjusted for evasion, by applying a group collection ratio. The process is repeated for each group. The transfer payments are programmed to account for government transfer payments and for rents, interest, and profit income that accrues to groups other than capitalists.

Finally, the model investigates income distribution by households, which are considered to be the unit of income recipients. Households are classified into 15 classes, according to the occupation of the head of the household. It is assumed that the within-class distribution of income in each of the household classes has the same lognormal form as the within-category distributions of workers' income.

The overall size distribution is calculated numerically by adding the group distributions. As information at this stage is sufficient, it is not necessary to assume some distribution, such as the lognormal form, for the overall size distribution. The model computes directly various statistical inequality measures such as quantiles, quantile means, and Gini coefficients.

2.4.2 The present model in this research

The purpose of the present model is different from that of Adelman-Robinson. Namely, this model is intended neither to simulate income distribution policies nor to determine an optimized policy; rather, it aims to expose the functional income distribution under perfect competition, and to transform the functional to the benchmark personal income distribution separately. In that sense, the present model is somewhat simpler than Adelman-Robinson model, as it merely simulates a full market economy while

ignoring any description of market imperfections. The model assumes that laborers are freely mobile across sectors, so that each type of labor corresponds to a unique wage rate that is not affected by either sector type or firm size (as in the Adelman-Robinson model). In the present model, labor can substitute following a hierarchy from highly- to low skilled labor; the wage of highly-skilled labor will therefore not be less than that of low skilled labor. In the model, capital is completely immobile; it is assumed to be fixed in sector and location. Among sectors, the difference in rental rates of fixed capital is caused by the different technologies only.

The model is a static Walrasian general equilibrium model generating functional distributions. It is built multisectorally and multiregionally. The model applies to the Chinese economy with most of her provincial economies, each of which has 30 sectors. Slightly different from the Adelman-Robinson model, the present model includes 30 commodities, 29 of which are tradable and one of which is nontradable, because the provincial input-output tables show zero on export and import items only in the 30th commodity or service.[14]

The objective of the model in this research is to maximize the overall final use, which is domestic final demand excluding international trade, subject to commodity, capital and labor constraints. The production function is assumed to have a Leontief form. Denoting

i – provinces,

s – sectors,

K – capital input coefficient,

L – labor input coefficient,

X – output,

the production functions are as follows

$$X_s^i = min(K_s^i X_s^i, L_s^i X_s^i).$$

Denoting

A_t – intermediate input coefficient of tradable goods,

A – intermediate input coefficient of nontradable good,

f_t – the composition of the provincial final demand for tradable goods,

f – the composition of the provincial final demand for the nontradable good,

d – the share of the final uses of the province in overall domestic final use,

D – overall domestic final use,

[14]Provincial input-output tables in China, 1992.

the demand side consists of intermediate and final demands for tradable goods,

$$\sum_i A_t^i X^i + \sum_i f_t^i d^i D,$$

and for the nontradable good,

$$A^i X^i + f^i d^i D.$$

In factor markets, factor supplies are fixed, whereas demand is as follows:
for labor,

$$L^i X^i,$$

and for capital,

$$K^i X^i,$$

The payment of each province for the net exports to the rest of China is required to match the observed value. Denote

P_t – the competitive prices of tradable commodities,

the overall value of net exports of each province is

$$P_t[(I - A_t^i)X^i - f_t^i d^i D - E^i].$$

Consider net exports to the rest of the world to be fixed as an exogenous resource, and denote

E – net exports to the rest of the world,

N – labor force,

M – capital stock,

S_o – the observed overall value of net exports of each province,

the general equilibrium is reached when D reaches its maximum and commodities and factors are in balance:

Balance of tradable commodities

$$\sum_i X^i + \sum_i E^i = \sum_i A_t^i X^i + \sum_i f_t^i d^i D,$$

Balance of nontradable commodities

$$X^i = A^i X^i + f^i d^i D,$$

Balance of labors

$$N^i = L^i X^i,$$

Balance of fixed capital

$$M^i = K^i X^i.$$

Balance of provincial budgets

$$S_o^i = P_t[(I - A_t^i)X^i - f_t^i d^i D - E^i].$$

The Adelman-Robinson model was solved by a tatonnement-like process. The model in this research is also non-linear, but it consists of a large-scale linear program and a non-linear equation system. The primal program has 948 constraints and includes 811 variables. Among the constraints, tradable goods are 29; the non-tradable good constitutes 27 (one for each province); unskilled labor is one; other kinds of labors are 81 (three for each province); fixed capital constitutes 810 (30 for each province). The variables are 810 sector activities (30 for each province), plus one for the overall final use. The non-linear equation system consists of 27 equations and 27 variables. Each of the equations is the payment balance of a province. The variables are the shares of the final use of the province in the overall domestic final use. The system is solved by the Newton method.

The information requirements of the Adelman-Robinson model and others are huge; hundreds of parameters have to be estimated. The model in this research requires minimal information: first, sector technologies (which are given by input-output tables, and utilize labor and fixed capital information); second, consumer's preferences (which are represented by the composition of domestic final use in the input-output table); third, endowments (consisting of labor resources, fixed capital stocks and fixed trade abroad).

Unlike Adelman and Robinson, who directly transform the functional to the personal income distribution in their model, I do the transformation outside the model. The transformation is the basic requirement for the economic modelling on personal income distributions. As Sahota (1985) pointed out, the link between functional and personal income distribution is one of the most intractable in modern economics. The reason is that functional and personal income distributions belong to two different regimes. To express personal income in terms of functional income requires information on the ownership of factor quantities, particularly on the ownership of capital.

However, most of the required information either does not exist or is costly to collect. One therefore has to estimate it, or simplify one's objectives. Practically, the connection between functional and personal income distribution could be a key to evaluate the quality of a modelling on personal income distribution. The Adelman-Robinson model builds a bridge by assuming that any within-category size distribution has a lognormal form. In the Taylor-Lysy model, the key assumption is that capital income is appropriated by capitalists only, and not by labor. The Sahota model assigns the capital owned by different income classes into different sectors to identify ownership. This research follows Taylor-Lysy's assumption that the capitalist is the sole earner of rent on private capital.

Chapter 3

Measures of Income Inequality

3.1 Introduction

A quantitative measurement of personal income distribution will provide explicit and precise information to reveal the ranking of personal income distributions. Many methods have been proposed to measure distribution. Because these methods differ in design, the results obtained by the methods may yield different approaches. Thus, selecting the appropriate measures for a special study on personal income distribution is an important part of researching income distribution. This chapter, by discussing the existing popular methods for quantitatively measuring the degree of income inequality, aims to identify those measures that best suit the research.

The measures of income inequality can be categorized into 'positive' and 'normative' methods. Positive measures arose earlier than normative measures. The former is designed statistically, and presents social welfare implicitly. The design of the latter is based on an explicit formulation of social welfare. The family of positive measures includes the Relative mean deviation, Variance, Coefficient of variation, Variance of logarithms, Standard deviation of logarithms, the Gini Coefficient, and the Theil index; the family of normative measures includes the Dalton measure, the Atkinson measure, and the Sen measure. Although some economists advocate normative measures, the positive measures are frequently applied because they are perhaps more relevant to practice.[1] However, the applications of the positive measures have their problems, as different measures may lead to different conclusions. To solve this problem, researchers recently devised a way to discriminate the positive measures. It was

[1] Foster (1994) analyzed this situation.

found that if the measures are examined in conjunction with certain properties that any measure of income inequality should possess, that some positive measures will become disqualified and therefore may be eliminated.

In general, the more properties that are added to justify the measures, the fewer measures remain qualified. Fields and Fei (1978) identified three properties as the basic properties that an inequality measure should satisfy, namely, the Pigou-Dalton income transfer principle, Symmetry, and Income homogeneity, respectively. Dasgupta, Sen and Starrett (1973) proposed the additional property of Population homogeneity. In addition, Additive decomposability was often recommended as a necessary property, as the measures used for the analysis of income distribution involve total inequality and subgroup inequalities. Bourguignon (1979), Shorrocks (1980), and Foster (1983) proved that the Theil index was the only one satisfying all five properties. Furthermore, Shorrocks (1988) proved that the Theil index is also the only one satisfying subgroup monotonicity.

Although the Theil index possesses nice properties, it has not been applied to sufficient extent. In particular, the Theil index has to rely on an exogenously assumed statistical form of income distribution to observe the within-group inequality – which apparently violates the definition of the Theil index. This chapter solves the problem by extending the Theil index to include only between-group inequalities, since by additive decomposability between-group inequality can be studied in itself. As a result, the extended Theil index can be applied purely based on the definition of the Theil index, and can provide information on income inequality in more aspects.

The study in this chapter will be conducted as follows. Section 3.2 briefly reviews the popular measures in the family of positive measures and the Atkinson measure in the family of normative measures. In this section, particularly detailed discussion, however, is given to the Theil index, based on Theil (1963). Section 3.3 discusses the properties of the measure of income inequality and concludes that the Theil index is the proper measure of income inequality for this research. Furthermore, to reconcile the Theil index with the requirement of this research, Section 3.4 develops an extended form of the Theil Index, with which the overall inequality is further decomposed into multiple between-group inequalities so that the final within-group inequalities can be reasonably ignored. Finally, Section 3.5 presents two programs of application of the extended form. These will jointly measure the inequalities in the current Chinese economy in Chapter 4, and in a hypothetical competitive market in Chapter 7.

3.2 Measures of income inequality

3.2.1 Relative mean deviation

In statistics, the extent to which some variable differs across the population of numbers may be summarized by the average difference between all values of this variable and its mean. This difference is positive when the variable is larger than the mean, and negative otherwise. Because the sum of total differences is zero, in order to calculate the average difference, statisticians avoid the zero sum by taking the absolute values of all differences and then getting the average. This average is called the mean absolute deviation. Because the deviations depend on the mean, they are divided by the mean to make them scale independent. This is the relative mean deviation. Since Brescian and Turroni,[2] the relative mean deviation has been recommended as a measure of income inequality due to its simplicity.

Definition: Relative mean deviation *For a population with N individuals, let I_j denote the absolute income level of individual, $j = 1, ..., N$ and let $\bar{y}$ indicate the average income of all individuals. The relative mean deviation, (RMD), is that*

$$RMD = \frac{\sum_{j=1}^{N} |I_j - \bar{I}|}{N\bar{I}}.$$

RMD, however, is seldom used, because it is insensitive to income transfers happening in the same side of the mean income. For example, assume that both I_1 and I_2 lie on the side below the mean income, and that after an income transfer, ΔI, from I_1 to I_2 they both still remain in the same side, then

$$\begin{aligned} RMD &= \frac{\sum_{j=3}^{N} |I_j - \bar{I}| + |I_1 - \Delta I - \bar{I}| + |I_2 + \Delta I - \bar{I}|}{N\bar{I}} \\ &= \frac{\sum_{j=3}^{N} |I_j - \bar{I}| + |I_1 - \bar{I}| + \Delta I + |I_2 - \bar{I}| - \Delta I}{N\bar{I}} \\ &= \frac{\sum_{j=1}^{N} |I_j - \bar{I}|}{N\bar{I}}. \end{aligned}$$

The RMD remains constant in this case. One way to overcome this problem would be to exaggerate the income differences by squaring them. Use of the squared methods can help capture the impact of an income transfer on income difference. These squared methods are the variance and the coefficient of variation.

[2]See, Kakwani (1980)

3.2.2 Variance and coefficient of variation

The variance was a statistical method. Applied to measuring income inequalities, the method calculates the average squared difference between individuals' incomes and their average income.

Definition: Variance *For a population with N individuals, let I_j denote the absolute income level of an individual, and let $\bar{I}$ indicate the average income of all individuals. The variance (V) is given by*

$$V = \frac{\sum_{j=1}^{N}(I_j - \bar{I})^2}{N}$$

Like RMD, the variance is also simple. Moreover, it is sensitive to income transfers for all income levels. The problems with the variance are that it is dependent on the mean income level and the measurement unit of income. For example, assume that distribution A's mean income is to some extent lower than distribution B's mean income, and that a relatively great variation happens in distribution A and a relatively small variation happens in distribution B. In that case, the variance may record a larger value on distribution B than on distribution A. The variance depends on the measurement unit of income because the variance measures the average squared difference in income level. These drawbacks are avoided by the coefficient of variation, which eliminates the scale by dividing the square root of the variance over the mean income.

Definition: Coefficient of variation *The coefficient of variation (CV) is*

$$CV = \frac{V^{\frac{1}{2}}}{\bar{I}}$$

The problem with the CV is that it attaches equal weights to income transfers at different income levels.[3] For example, assume that there are two income transfers of the same amount; one transfers 100 from a person whose income is 10,000 to another whose income is 9000, another transfers 100 from a person whose income is 1000 to another whose income is 900. In that case, the CV will record the same impact of income transfer for both the transfers. However, there are other measures that do not have this drawback. One of these is the family of logarithmic measures.

[3]Sen (1973), p. 28.

3.2.3 Variance of logarithms and standard derivation of logarithms

The family of logarithm measures includes variance of logarithms and standard deviation of logarithms. The logarithm measures possess the properties that RMD, V and CV do, except that they are not as simple as the RMD, V and CV because of the logarithm form. In addition, the logarithm measures can attach importance to income transfers at the lower end.

Definition: Variance of logarithms *The variance of logarithms (VL) is that*

$$VL = \frac{\sum_{j=1}^{N}(\log I_j - \log \bar{I})^2}{N}$$

Definition: Standard deviation of logarithms The standard deviation of logarithms (SDL) is that

$$SDL = VL^{\frac{1}{2}}$$

Common between the above measures is that all of them consider income differences between each income and the mean income. However, it is also desirable that income differences can be measured between all the pairs of income. The Gini coefficient is this kind of measure of income distribution.

3.2.4 The Lorenz curve and the Gini coefficient

The Gini coefficient is often defined with the Lorenz curve, which was introduced by Lorenz (1905) to measure the concentration of wealth. The Gini coefficient is an index based upon the Lorenz curve.[4] The Lorenz curve reflects the comparative position between the cumulative proportion of income and the cumulative proportion of the population in a simple way. The below figure illustrates this idea.

[4]Kakwani (1980) gave a comprehensive exposition of both.

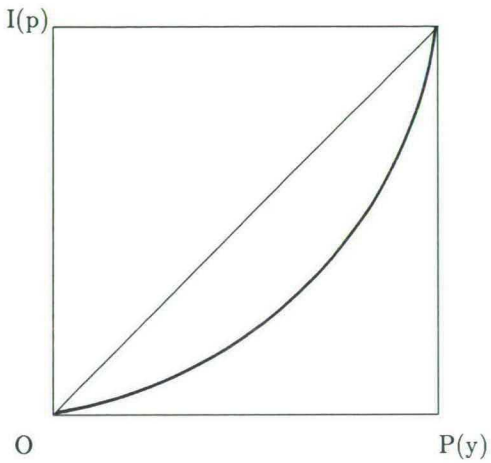


Figure: Lorenz curves

In the figure, the horizontal axis indicates the cumulative proportion of the population, while the vertical axis indicates the cumulative proportion of income corresponding to the proportions of the population. Each point onthe Lorenz curve points out how large the proportion of income is possessed by a given proportion of the population with the lowest incomes. Thus, a diagonal line represents the egalitarian distribution, and the lines (OPO_1) state the case of absolute inequality. The Lorenz curve will be located in between these two extremes.

Definition: Lorenz curve *Let I indicate the income level, let $P(I)$ indicate the cumulative proportion of the population whose income is lower than or equal to I, and let $L(P)$ indicate the cumulative proportion of total income of the population P. Then, the Lorenz curve is the graph of the function $L(P)$.*

Definition: Lorenz superiority *Income distribution A is* **Lorenz superior** *to an income distribution B if $L^A(P(I)) \geq L^B(P(I))$ for any P.*

In general, the Lorenz curve can provide the precise figures of some income distributions, and can even reveal the rankings of the income distributions by the concept of Lorenz superiority. However, because the Lorenz curve is unable to provide numerical results on income distribution, it will encounter problems in comparing income distributions when the Lorenz curves of the income distributions intersect each other. In that case, Lorenz superiority is not applicable to reveal the rankings of income distributions. A numerical measure that can reveal the ranking of income distributions is the Gini coefficient.

Definition: Gini coefficient *The Gini coefficient (Gini) is the ratio of the area between the egalitarian line and the Lorenz curve to the area between the egalitarian line and the absolute inequality curve.*

Formally, the Gini coefficient is that (for the continuous case),

$$Gini = 1 - 2\int_0^1 L(P)dP,$$

and let y indicate income share (for the discrete case),

$$Gini = 1 + \frac{1}{N} - 2\sum_{j=1}^{N} y(I_j)P(I_{N+1-j}),$$

where $y(I_j) = \frac{I_j}{\sum_{j=1}^{N} I_j}$.

The Gini coefficient is one of the most popular measures of income inequality, because of its simple way to explain inequality. A weak point is that Gini's decomposability is limited. There exist some measures that have additive decomposability; among them, Theil's index is a popular one.

3.2.5 Theil's index

Theil's index, proposed by Theil (1967), is based on entropy in information theory. Because of its logarithm form, the Theil index is not as simple as the Gini coefficient, but it can be divided into between-group and within-group inequalities. In particular, Theil's index possesses the properties of the Pigou-Dalton transfer principle, Symmetry, Income homogeneity, Population homogeneity, Additive decomposability and Monotonicity, which are proposed to be fulfilled by qualified measures of income inequality, which makes it attractive for application.

Definition: Theil's index *Theil's index is the logarithm of the geometric mean of the ratios of each individual's income to per capita income in the population, weighted by the individual's income.*

Total Theil's inequality can be decomposed into between-group and within-group inequalities. The between-group inequality is the logarithm of the geometric mean of the ratios of each per capita income in each group to per capita income in the total population, weighted by the per capita income in each group. The within-group inequality is the logarithm of the geometric mean of the geometric mean of the ratios of each individual's income to per capita income in the group, weighted by the individual's income and the group's per capita income.

If N individuals with total I income, the income of each of which is I_j and the income share of each is y_j for $j = 1, ..., N$ and $\sum_{j=1}^{N} y_j = 1$, can be divided into G groups and each of them includes N_g individuals with total I_g income, and the sum of income shares of individuals in each group is $Y_g = \sum_{j=1}^{N_g} y_j$ for $g = 1...G$, and let $\bar{I}_g$ and $\bar{I}$ indicate per capita income in group g and in the total population, respectively, then Theil's index can be expressed as follows:

$$
\begin{aligned}
e^{\text{Total inequality}} &= \prod_{j=1}^{N} \left(\frac{I_j}{\bar{I}}\right)^{I_j} \\
e^{\text{Between-group inequality}} &= \prod_{g=1}^{G} \left(\frac{\bar{I}_g}{\bar{I}}\right)^{\bar{I}_g} \\
e^{\text{Total within-group inequality}} &\times \prod_{g=1}^{G} \left(\prod_{j=1}^{N_g} \left(\frac{I_j}{\bar{I}_g}\right)^{I_j}\right)^{\bar{I}_g}
\end{aligned}
$$

These forms can be written in term of the income shares:

$$
\begin{aligned}
e^{\text{Total inequality}} &= \prod_{j=1}^{N} (y_j N)^{y_j} \\
e^{\text{Between-group inequality}} &= \prod_{g=1}^{G} \left(\frac{Y_g N}{N_g}\right)^{Y_g} \\
e^{\text{Total within-group inequality}} &\times \prod_{g=1}^{G} Y_g \left(\prod_{j=1}^{N_g} \left(\frac{y_j N_g}{Y_g}\right)^{y_j}\right)^{Y_g}
\end{aligned}
\tag{3.1}
$$

Theil's index is obtained by taking the logarithmic form of the above forms:

$$
\begin{aligned}
\text{Total Theil's inequality:} \quad & \sum_{j=1}^{N} y_j \log N y_j = \\
\text{Between-group inequality:} \quad & \sum_{g=1}^{G} Y_g \log N \frac{Y_g}{N_g} + \\
\text{Average within-group inequality:} \quad & \sum_{g=1}^{G} Y_g \sum_{j=1}^{N_g} \frac{y_j}{Y_g} \log N_g \frac{y_j}{Y_g}
\end{aligned}
\tag{3.2}
$$

3.2.6 Atkinson's measure

The positive family of income measures faced the difficulty that the empirical results revealed by different measures within the family were often contradictory. This problem reduces the credibility of this family. Atkinson (1970) showed the inconsistency in the measurements between the Gini coefficient, the Standard deviation of logarithms and the Coefficient of variation, by means of which he measured and compared the degree of income inequality in 12 countries. This problem has drawn economists' attention to the social welfare behind the measures. It is argued that the existing positive measures implicitly describe social welfare, so that all of them in fact reveal a partial rather than a complete ranking. A proper measure should consider social welfare explicitly; such a measure is therefore called a 'normative measure'. Dalton (1920) was the first to notice the specific welfare properties implied by positive measures. He proposed a direct use of the social welfare function. Atkinson (1970) developed a new measure to avoid the variance with respect to linear transformations of the utility function used in Dalton's measure. Subsequently, Sen (1973) generalized Atkinson's measure by introducing a more general social welfare function. Because Atkinson's measure is a typical measure among the family of normative measures, I shall briefly introduce it in this section.

Definition: Atkinson measure *The Atkinson measure is one minus the ratio of the equally distributed equivalent level of income, I_E, in the equally distributed distribution to the mean, $\bar{I}$, of the level of income in the actual distribution.*

$$\text{Atkinson's measure} = 1 - \frac{I_E}{\bar{I}.}$$

If the social welfare function is homothetic, and let $f(I_j)$ denote the individuals distribution by income, then

$$I_E = \sum_{j=1}^{N} [(I_j)^{1-\epsilon} f(I_j)]^{\frac{1}{1-\epsilon}}$$

The only parameter in the measure is ϵ, which reflects the degree of inequality aversion or the relative sensitivity of inequality to transfers at different income levels. Because the parameter needs to be designed artificially, Atkinson's measure has not been widely applied.

Normative measures have nice theoretical properties, but they cannot yet substitute for positive measures. As Foster (1994) pointed out, it is difficult in practice to

specify the utility function for a normative measure and, more generally, the identification of inequality with welfare loss might require a more explicit definition of feasible redistribution.

In addition to searching the substitution for positive measure in the field of normative measures, economists have recently also worked on identifying the qualification of the positive measures by properties that any qualified measure should possess. The more properties that are adopted, the fewer measures hat will remain qualified. The next section will discuss the basic properties of the income inequality measure and the evaluation on positive measures in detail to prove that Theil's index is the only one fulfilling basic characterizations.

3.3 Properties of measures

Although simplicity is important for any income inequality measures, it cannot assure the qualification of a measure of income inequality. The previous section introduced a number of popular positive and normative measures without specifying their properties. In general, every income inequality measure is characterized by certain properties or axioms. The basic proposed axioms are the Pigou-Dalton transfer principle, Symmetry, Income homogeneity and Population homogeneity. In some cases, Additive decomposability and Monotonicity are added. Fields and Fei (1978), Cowell and Kuga (1981), Shorrocks (1980), Foster (1983) et al. found that the Coefficient of variation, the Gini coefficient, the Atkinson measure and Theil's index fulfiled all four of the basic axioms. Foster (1983) proved that Theil's index additionally possessed Additive decomposability. Shorrocks (1988) further showed that Theil's index also satisfied Monotonicity.

An essential property of an income inequality measure is that if income is transferred from the poor to the rich, inequality shall increase. Pigou (1912) and Dalton (1920) first proposed this property.

Pigou-Dalton income transfer principle

Any income transfer from low to high increases inequality.

Symmetry

Inequality is invariant to the identification of individuals.

The measure has symmetry, if different permutations of individuals do not yield different inequalities.

Income homogeneity

Inequality depends on the relative levels of individuals' income, but is independent of the absolute levels of individuals' income in a distribution.

This axiom means that when two distributions differ only in the absolute levels of their income, the two have equivalent inequality. This property enables comparison to be made between income distributions without considering the difference in mean income levels.

Theorem 3.3.1 *The Coefficient of variation, the Variance of logarithms, the Gini coefficient, Theil's index and the Atkinson measure possess all three properties.*

Fields and Fei (1978) and Fields (1980) have proved this theorem. Atkinson (1970) stated that Variance failed Income homogeneity and that the Relative mean deviation was insensitive to transfers on the same side of the mean and therefore could not fulfil the Transfer principle.

Besides the three mentioned axioms, Dasgupta, Sen and Starrett (1973) proposed Population homogeneity. This axiom may not be included in the family of basic properties, but it is important to compare the inequality between populations of different sizes. It has therefore been discussed in Shorrocks (1980), Foster (1983) and others.

Population homogeneity

Inequality of a population is not changed if the population is replicated.

With this property, inequality depends on the proportion of individuals in each income level, but is independent of the population size. The property means that two distributions with the same income proportions but with different population sizes have identical inequalities.

Theorem 3.3.2 *Among the income inequality measures satisfying the Pigou-Dalton transfer principle, Symmetry and Income homogeneity and Population homogeneity, Coefficient of variation, Variance of logarithms, the Gini coefficient and Theil's index also fulfil the Population homogeneity.*

Dasgupta, Sen and Starrett (1973) showed that Atkinson's measure fulfilled this property. Shorrocks (1980) showed that the Coefficient of variation, Variance of logarithms and Theil's index satisfied the Population homogeneity. It is trivial to see that the Gini coefficient also has this property.

Income inequality measures are often demanded for addressing various contributory factors in applications. The property of Additive decomposability enables the income inequality measures to meet the demands.

Additive decomposability

The inequality of an income distribution can be divided into the inequality within its subgroups and the inequality between its subgroups. Total inequality is equivalent to the sum of the average of the inequality within subgroups and the inequality between the subgroups.

Theorem 3.3.3 *Theil's index is the only measure satisfying all the five axioms.*

The theorem has been proved by Foster (1983).

Monotonicity

If only a within-group inequality changes while all others stay the same, then the overall inequality must change by the same amount.

Theorem 3.3.4 *Theil's index satisfies Monotonicity.*

The theorem has been proved by Shorrocks (1988).

3.4 The extended form of Theil's index

Theil's measure, as Theil himself has realized, must depend on the information available on the specification of each individual's income. When there are many individuals whose income is less likely to be specified, the method will encounter calculation problems. To handle this problem, Theil (1967) proposed an approach of ordinary income distribution, which dealt with the case that only the number of individuals in any given income interval was specified, rather than the income of each individual. The key of this approach is to assume the statistical form of the income distribution. For example, the lognormal distribution and the Pareto distribution can be used. Under lognormal distribution, the total within-group inequality of Theil's index is equal to half the variance of the natural logarithm of income shares. Let σ^2 be the variance of the natural logarithm of income shares,

$$\text{Theil's Index} = \frac{1}{2}\sigma^2,$$

Denote α as the Pareto parameter, which Pareto found to be approximately 1.5. Under the Pareto distribution, Theil (1967) derived that

$$\text{Theil's Index} = \frac{1}{\alpha - 1} - \log \frac{\alpha}{\alpha - 1}.$$

The weakness of this approach is obviously that the results depend on the specific distributions. Nevertheless, there is an alternative way to avoid this specification

problem. Income differences among individuals are usually shown from various factors such as individuals' skills, social stage, property, location, etc.. If one can identify the inequalities resulting from each of these factors separately, the residual should be zero when unconsidered factors are ignored. The proposed method in this section is to multiply classified individuals into groups, until the individuals in the same group have roughly the same incomes. This method, in fact, divides total inequality into various between-group inequalities and ends up with within-group inequalities that are caused by unconsidered factors. The multiple classifications require an extension of Theil's measure being capable of decomposing the overall inequality into various between-group inequalities. This extension is made in this section.

Assuming that there are N individuals, the income share of individual j is y_j, and these are such that $\sum_{j=1}^{N} y_j = 1$. First, divide all individuals into G groups, $S_1, ..., S_G$. Let N_g denote the number of individuals in S_g, $g = 1, ..., G$, summing to N,

$$\sum_{g=1}^{G} N_g = N,$$

and the income share of S_g is

$$Y_g = \sum_{j=1}^{N_g} y_{gj}.$$

The entropy within g group is

$$H_g(y) = \sum_{j=1}^{N_g} \frac{y_{gj}}{Y_g} \log \frac{Y_g}{y_{gj}}$$

A Theil entropy $H(y)$ may therefore be expressed as follows:

$$\begin{aligned} H(y) &= \sum_{g=1}^{G} \sum_{j=1}^{N_g} y_{gj} \log \frac{1}{y_{gj}} \\ &= \sum_{g=1}^{G} Y_g \log \frac{1}{Y_g} + \sum_{g=1}^{G} Y_g H_g(y). \end{aligned}$$

On the basis of the above entropies, Theil (1967) obtained an inequality measure by subtracting $H(y)$ from its maximum value, $\log N$, as follows:

$$\log N - H(y) = \sum_{j=1}^{N} y_j \log y_j N$$

$$= \sum_{g=1}^{G} Y_g \log \frac{Y_g}{N_g/N}$$
$$+ \sum_{g=1}^{G} Y_g \sum_{j=1}^{N_g} \frac{y_{gj}}{Y_g} \log \frac{y_{gj}/Y_g}{1/N_g}$$

This is the well-known Theil index measure of income inequality. The left-hand side expresses the overall inequality. The first term on the right-hand side deals with the between-group inequality, while the second term reflects the average of total within-group inequalities.

Further, divide the individuals in S_g into F subgroups, $T_1, ..., T_F$, according to some other criterion. In this case,

$$\sum_{f=1}^{F} N_{gf} = N_g,$$

and

$$\sum_{g=1}^{G} \sum_{f=1}^{F} N_{gf} = N.$$

Let y_{gfj} denote the income share of individual j in the subgroup f in the group g in total income of the population, the income share of subgroup f is

$$Y_{gf} = \sum_{j=1}^{N_{gf}} y_{gfj},$$

the entropy of subgroup f can be written as

$$H_{gf}(y) = \sum_{j=1}^{N_{gf}} \frac{y_{gfj}}{Y_{gf}} \log \frac{Y_{gf}}{y_{gfj}},$$

and the entropy of group g can be written as

$$H_g(y) = \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \log \frac{Y_g}{Y_{gf}},$$

then the overall Theil entropy $H(y)$ can be written as

$$H(y) = \sum_{g=1}^{G} \sum_{f=1}^{F} \sum_{j=1}^{N_f} y_{gfj} \log \frac{1}{y_{gfj}}$$
$$= \sum_{g=1}^{G} Y_g \log \frac{1}{Y_g} + \sum_{g=1}^{G} Y_g H_g(y) + \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} H_{gf}(y).$$

On the right-hand side, the first term is the entropy between G groups, the second term is the average of the entropies between F subgroups in all G groups, and the third term is the average of the entropies in all F subgroups and in all G groups. Following Theil, an extensive form of Theil's index with respect to a two-times classification can be developed as follows:

$$\begin{aligned}\log N - H(y) &= \sum_{g=1}^{G} Y_g \log \frac{Y_g}{N_g/N} \\ &+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \log \frac{Y_{gf}/Y_g}{N_{gf}/N_g} \\ &+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \sum_{j=1}^{N_{gf}} \frac{y_{gfj}}{Y_{gf}} \log \frac{y_{gfj}/Y_{gf}}{1/N_{gf}}.\end{aligned}$$

When there are m times classifications, the total entropy is obtained by further decomposing subgroups into subsubgroups and so on. That is

$$\begin{aligned}H(y) &= \sum_{g=1}^{G}\sum_{f=1}^{F}\sum_{e=1}^{E}\cdots\sum_{m=1}^{M}\sum_{j=1}^{N_m} y_j \log \frac{1}{y_j} \\ &= \sum_{g=1}^{G} Y_g \log \frac{1}{Y_g} \\ &+ \sum_{g=1}^{G} Y_g H_g(y) \\ &+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} H_{gf}(y) \\ &+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \sum_{e=1}^{E} \frac{Y_{gfe}}{Y_{gf}} H_{gfe}(y) \\ &+ \cdots\cdots\cdots \\ &+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \sum_{e=1}^{E} \frac{Y_{gfe}}{Y_{gf}} \cdots \sum_{m=1}^{M} \frac{Y_{g\ldots m}}{Y_{g\ldots p}} H_{g\ldots m}(y)\end{aligned}$$

The general form of the extended Theil's index is

$$\begin{aligned}\log N - H(y) &= \sum_{j=1}^{N} y_j \log \frac{y_j}{1/N} \\ &= \sum_{g=1}^{G} Y_g \log \frac{Y_g}{N_g/N}\end{aligned}$$

$$
\begin{aligned}
&+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \log \frac{Y_{gf}/Y_g}{N_{gf}/N_g} \\
&+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \sum_{e=1}^{E} \frac{Y_{gfe}}{Y_{gf}} \log \frac{Y_{gfe}/Y_{gf}}{N_{gfe}/N_{gf}} \\
&+ \cdots\cdots \\
&+ \sum_{g=1}^{G} Y_g \sum_{f=1}^{F} \frac{Y_{gf}}{Y_g} \sum_{e=1}^{E} \frac{Y_{gfe}}{Y_{gf}} \\
&\cdots \sum_{m=1}^{M} \frac{Y_{g\ldots m}}{Y_{g\ldots p}} \sum_{j=1}^{N_{g\ldots m}} \frac{y_{g\ldots mi}}{Y_{g\ldots m}} \log \frac{y_{g\ldots mj}/Y_{g\ldots m}}{1/N_{g\ldots m}}.
\end{aligned}
$$

3.4.1 An example

This research intends to apply the extended form of Theil's index to measure income inequalities regarding the current and hypothetical Chinese economy. Because these direct applications are a bit complex, I present an example for a twofold purpose: to demonstrate the function of the extended form of Theil's measure and to introduce the applications briefly. In the example, an economy is considered consisting of two types of population, labor and non-labor. There are two areas, rural and urban, and two provinces, developed and under-developed. Because the area and province overlap, to specify each individual in the economy, the population must be classified twice according to the area and the province where they reside. In principle, there are alternative ways to identify the population. In the first way, the population members are divided into two groups by area: the population in the rural area and the population in the urban area; then, the people in each area are further separated into two subgroups by province: the population in the developed province in the rural area, in the under-developed province in the rural area, in the developed province in the urban area, and in the under-developed province in the urban area. In the second way to identify the population, the population is divided first of all into two groups by province: the population in the developed province and the population in the under-developed province; the population in each province is then further separated into two subgroups by area: the population in the rural area in the developed province, in the urban area in the developed province, in the rural area in the under-developed province, and in the urban area in the under-developed province.

The first program provides the following four sets of information: overall inequality, inequality between rural and urban areas, inequality between provinces in rural

and in urban areas, and inequality between social classes in provinces and areas. The second program provides the following four sets of information: overall inequality, inequality between developed and under-developed provinces, inequality between areas in developed and in under-developed provinces, and inequality between social classes in provinces and areas. The two programs have exactly same results regarding the overall inequality and the inequality between social classes in areas and in provinces. However, they are different in the second and the third term. The second term in the first program is an overall inequality between areas in the economy, but the program cannot show separately the inequality between areas in each province. The third term in the second program provides the inequality between areas in each province and also the average of the inequalities. However, the average of the inequality between areas in provinces in the second program in general is not equal to the overall inequality between areas in the first program, even though the two are intuitively same. This difference is caused by the use of different methods, which I shall discuss in detail immediately after the example. Similarly, the third term in the first program provides the inequality between provinces and the average of the inequalities, while the second term in the second program is an overall inequality between provinces in the economy. The combination of the two programs will be complements in providing a complete set information on the inequality regarding the economy, its areas and provinces.

The information in the two programs is presented in the following tables:

		Developed province	Under-developed province
Rural area	Non-labor	1	1
	Labor	1	1
Urban area	Non-labor	1	1
	Labor	1	1

Table 3.*a* Population allocation in program 1.

		Developed province	Under-developed province
Rural area	Non-labor	1	1
	Labor	2	2
Urban area	Non-labor	5	3
	Labor	6	4

Table 3.*b* Income distribution in program 1.

		Rural	Urban
Developed province	Non-labor	1	1
	Labor	1	1
Under-developed province	Non-labor	1	1
	Labor	1	1

Table 3.*c* Population allocation in program 2.

		Rural	Urban
Developed province	Non-labor	1	5
	Labor	2	6
Under-developed province	Non-labor	1	3
	Labor	2	4

Table 3.*d* Income distribution in program 2.

Given the information, Theil's index in either program is calculated as follows:

	Program 1	Program 2	Combination
Overall inequality	0.0732	0.0732	0.0732
Overall inequality between areas	0.0568	-	0.0568
Overall inequality between provinces	-	0.0061	0.0061
The average of the inequality between provinces in each area	0.0081	-	0.0081
The inequality between provinces in the rural area	0	-	0
The inequality between provinces in the urban area	0.011	-	0.011
The average of the inequality between areas in each province	-	0.0588	0.0588
The inequality between areas in the developed province	-	0.0754	0.0754
The inequality between areas in the under-developed province	-	0.0357	0.0357
The average of the inequality between population types in areas and provinces	0.0083	0.0083	0.0083

Table 3.*e* Inequalities in program 1 and 2.

In both cases, the overall inequality and the inequality among the population types within both areas and provinces remain constant. Note, however, that the overall inequality between areas in program 1 is not equal to the average of the inequality between areas in provinces in program 2, and the overall inequality between provinces in program 2 is not equal to the average of the inequality between provinces in areas in program 2. There are small differences between them, which result from the different way used to approach the inequality. In the practice of this research, these different approaches cause very little differences between the inequalities, so that the differences can be neglected.

Denote G as area grouping and F as province grouping, and denote TBG as the inequality between G groups, $\bar{I}_g = \frac{I_g}{N_g}$ as per capita income in group g, and $\bar{I} = \frac{I}{N}$ as per capita income in the total population; for the sake of simplicity the exponential form of the Theil inequality between G groups with program 1 is written as

$$e^{TBG} = \prod_{g=1}^{G} \left(\frac{Y_g}{N_g/N}\right)^{Y_g} \tag{3.3}$$

$$= \prod_{g=1}^{G} \left(\frac{\bar{I}_g}{\bar{I}}\right)^{\frac{I_g}{I}} \tag{3.4}$$

Similarly, the exponential form of the average of the inequalities between subgroups G in all F groups with program 2 is written as

$$e^{T_{\text{within F groups}}} = \prod_{f=1}^{F} \left(\prod_{g=1}^{N_f} \left(\frac{y_{fg}/Y_f}{1/N_f}\right)^{y_g}\right)^{Y_f} \tag{3.5}$$

$$= \prod_{f=1}^{F} \left(\prod_{g=1}^{N_f} \left(\frac{y_{fg}}{\bar{I}_f}\right)^{\frac{I_{fg}}{I_f}}\right)^{\frac{I_f}{I}} \tag{3.6}$$

By definition, total Theil's inequality is the logarithm of a geometric mean, weighted by the weights of per capita income in total income, of the ratios of each individual's income to the mean income. In program 1, the overall inequality between areas is the logarithm of a geometric mean, weighted by the weights of income in each area in total income, of the ratios of the arithmetic means of each individual's income in each area to the mean income. In program 2, the average of the inequalities between areas in provinces is the logarithm of a geometric mean, weighted by the income in each area in total income, of the inequalities between areas in each province that is a

geometric mean, weighted by the weights of each individual's income in total income in each province, of the ratios of each individual's income to per capita income in each province.

3.5 Applications of the extended form of Theil's index

This section extends the dimensions of the previous example to suit the Chinese economy, whose population is classified in rural and urban areas, in 30 provinces, and in eight social classes that were discussed in Chapter 2. The application decomposes the overall income inequality in China into the inequality between rural and urban areas, the inequality between provinces, the inequality between social classes, and the inequality within social classes. The decomposition is additive as follows:

Overall inequality
= inequality between areas
+ inequality between provinces
+ inequality between social classes
+ inequality within social classes

As this research is interested in the income inequalities resulting from the differences in areas, regions and social classes, it assumes that the income inequalities within social classes are minor after the three major inequalities have been separated out of the overall inequality; I therefore ignore the existence of the income inequality within social classes. The assumption is based on the analysis on each of the social classes that income inequality within each social class is small. In the classes of technician, staff, skilled and unskilled worker, income differences between technicians, staff workers, skilled and unskilled workers result mainly from position and age. According to the Wage Reform Program of the Government (1993) in Table 3.f, the distance between top and bottom technicians is 505 Yuan, but there are 32 positions between the top and bottom. On average, the wage difference between any two adjacent positions is nearly 16 Yuan, which accounts for less than 10% of the bottom wage or 2.5% of the top wage. The distance between the top and bottom staff is 550 Yuan, but there are 47 positions between the top and bottom. On average, the wage difference between any two adjacent positions is nearly 12 Yuan, which accounts for less than 9% of the bottom wage or 2% of the top wage. The distance between the top and

bottom skilled workers is 274 Yuan, but there are also 47 positions between the top and bottom. On average, the wage difference between any two adjacent positions is nearly 6 Yuan, which accounts for only 4% of the bottom wage or 1.5% of the top wage. The distance between the top and bottom unskilled workers is 125 Yuan, but there are ten positions between the top and bottom. On average, the wage difference between any two adjacent positions is 12.5 Yuan, which accounts for only 9% of the bottom wage or 5% of the top wage. Since the retiree's income is accounted as the average of technician's, staff's, skilled and unskilled worker's incomes, and the dependant's income occupations also depend on the average, there should be a similar situation of income inequality within the retired and dependant class. However, there may exist big income differences within the self-employed and capitalist classes, but because these classes' income and population are still relatively small in current Chinese markets, the big inequalities in these classes will not significantly affect the average within-class inequality.

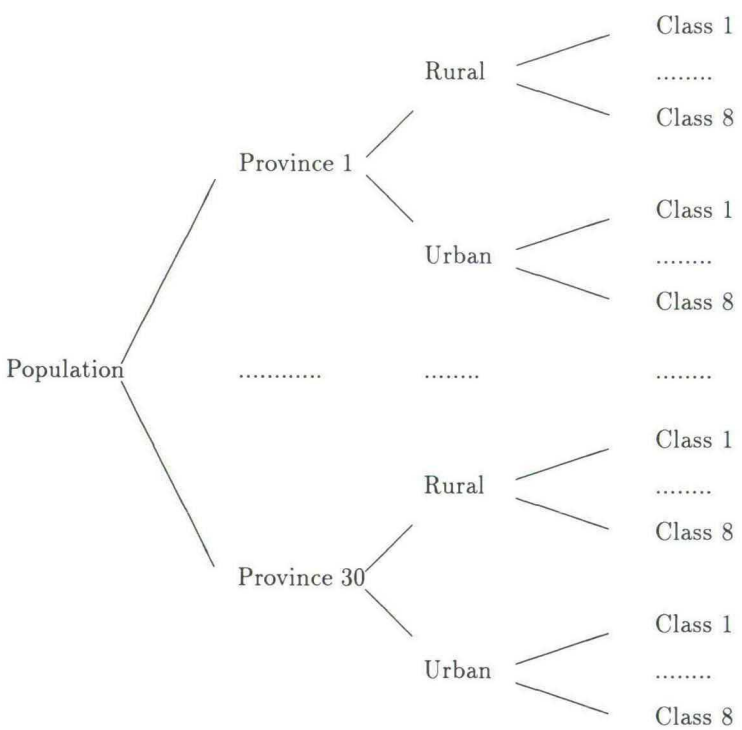
Occupations	Class	1	2	3	4	5	6	7	8	9	10
Technician	(1)	390	430	470	520	570	620	670			
	(2)	275	305	335	365	395	435	475	515	555	
	(3)	205	225	245	265	285	315	345	375	405	435
	(4)	165	179	193	213	233	253				
Staff	(1)	480	520	560	605	650	695				
	(2)	335	370	405	440	480	520	560			
	(3)	235	260	285	310	340	370	400	430		
	(4)	180	198	216	234	252	276	300	324	348	372
	(5)	160	174	188	202	216	233	250	267		
	(6)	145	157	169	181	193	207	221	235		
Skilled	(1)	245	267	289	315	341	367	393	419		
	(2)	205	223	241	259	283	307	331	355	379	
	(3)	180	196	212	228	248	268	288	308	328	348
	(4)	160	174	188	202	224	238	256	274	292	310
	(5)	145	157	169	181	197	213	229	245	261	277
Unskilled		135	146	157	168	182	196	210	224	242	260

Table 3.f Wage Reform in China in 1993

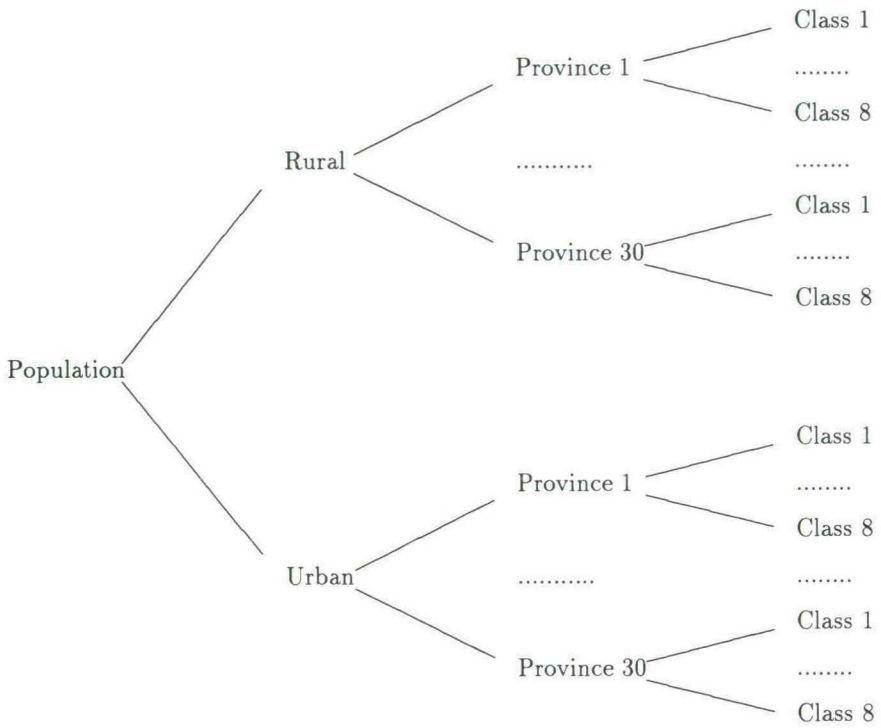
This section adopts two programs to decompose the Chinese economy, because a single program cannot provide sufficient information required by this research. The data gaps that remain in one program can be filled by the information from another program. In program 1, the population is divided by province first, and then each province is divided by area. In program 2, the population is divided by area first, and then each area is divided by province. Program 1 does not include the information on the overall inequality between areas and the inequalities between provinces in each area; program 2 does not have the information on the overall inequality between provinces and the inequalities between areas in each province. The final information set provided jointly by the two programs will be on inequality with respect to provinces, rural and urban areas, and social classes. These programs will be applied to measure the inequalities in the current Chinese economy in Chapter 4 and the inequalities in the competitive Chinese economy in Chapter 7.

Let G be area grouping, F province grouping, and E social class grouping. Theil's measures of the two programs have the following extended forms:

Program 1: First, the economy is divided into 30 provinces. Second, each province is separated into rural and urban areas. Third, the population in each area in each province is divided into eight social classes, namely unskilled labor, skilled labor, manager, technician, self-employed, capitalist, retiree, and dependant.



Program 2: First, the economy is divided into rural and urban areas. Second, each area is separated into 30 provinces. Third, the population in each area and province is divided into eight social classes.



Chapter 4

Income Distribution in the Current Chinese Economy

4.1 Introduction

China's 1978 economic reform started from income distribution. This reform aimed at changing the old centrally-controlled wage system to an income-setting system that advocates that people be paid for effort. This is, in fact, a change from egalitarian to efficiency. Time has shown that the reform indeed drives the development of the Chinese economy. Meanwhile, however, the economic reform has also caused some new problems, one of which is income inequality. In any economy, inequality is an important issue; if inequality becomes a serious problem, it will result in the instability of society, and further hurt the economy. At present, there is increasing concern that income inequality may become a sensitive problem, because people in many classes complain that income is being distributed unfairly – the rich are becoming richer, and the poor are becoming poorer.

This real economic problem is motivating economists to evaluate income distribution in the current Chinese market. Studies on the topic have mostly been involved with subjects such as inequalities in rural and urban areas, inequality between rural and urban areas, inequality in and between regions, and inequality between social classes. Much of the research work, like Zhu and Wen (1990), Griffin et al. (1994), and Wang et al. (1995), has investigated the inequality in rural areas and in urban area. A popular conclusion from those studies is that the inequality in either rural or urban areas is in fact within a proper range – it is not yet high enough to constitute

a serious problem. Moreover, there is more inequality in rural areas than in urban areas. It is also commonly observed that the inequality between rural and urban areas is significant and rigid. Wang et al. (1995) observed that the income difference between rural and urban areas was showing an increasing trend. In Yang (1992), the inequality was unbalanced across regions. The developed eastern part of China had more inequality than the less developed middle part and the least developed western part, and the middle and western parts had similar inequality. Moreover, Zhu and Wen (1990) and Griffin et al. (1994) found that there were no relationships between inequality and economic development in each province. As regards the income differences among social classes, studies have assured at similar conclusions that private owners and the self-employed earn the highest income, and low-skilled labor's income is close to that of high-skilled labor.

The existing studies reveal some features of the personal income distribution in the current Chinese market, but they are still far away from satisfactory, because most of the studies are based on rough data and analyze the data by superficial methods; the results thereafter are partial and limited. So far, the most popular information sources on personal income are the official data provided by the state and the local statistical and labor bureau through their regular surveys on households and labor. Unfortunately, these data are too general to be used directly for specific research. Without a careful specification on the data to be used, any research on personal income distribution that relies only and directly on the official data produces inevitably poor results. Unsatisfied with the official data, Griffin, et al. (1994) did a special sampling survey with respect to Chinese income. Owing to the huge population in China, this survey was able to collect only a very small amount of information. So far, the methods often adopted in studying personal income distribution are comparing the income means, calculating the mean deviations and the Gini coefficients. Gini coefficient is one of the most popular methods, but the income mean and the mean deviation, even though they can approach the income distribution roughly, have been disqualified for measuring income inequality. The conclusions obtained through the data and methods are therefore double.

It is possible to investigate personal income distribution more comprehensively. First, in addition to the Gini coefficient, other qualified methods exist that could be used to measure income inequality; Theil's index, in particular, which has been discussed extensively in Chapter 3, is attractive. So far, this method has not been applied popularly to measure income inequality in China. Second, existing informa-

tion sources could be utilized and developed more effectively. In fact, there exist many information sources such as statistical data, labor and wage data, census data, special surveys, samplings, and relevant literature. The problem is that the sources are usually presented in isolation. If they can be connected together to some extent, more information will become available. Inconsistencies and gaps in data abound in special research. To overcome these problems, researchers must consider derivation and estimation based on the relevant information.

This chapter attempts to study current personal income distribution by the extended form of Theil's index. The chapter includes three parts: a brief introduction to the Chinese economy, a description of data collection on population and personal income, and an application of Theil's index to measure income inequalities.

Section 2 will provide a general picture on the current economy of China. Since this research is especially applied to China, it is necessary to overview certain institutional and economic characteristics of the economy of China before going further to investigate one of its economic aspects – income distribution. The economic reform started in 1978 is perhaps the most important event in the history of China's communist government. Nowadays, this event not only affects Chinese life but also involves the world economy. Section 2 first addresses the economic reform before going on to introduce the economic foundations, structures and relations.

To calculate Theil's index, I need two sets of data: namely the population, which must be classified with respect to area, province and social class, and the corresponding incomes of the population categories. Section 3 describes the procedure of data collection. In that section, with respect to social class, the population is divided into eight classes by income source: the primary income earner (including unskilled, skilled, technician, manager, self-employed, and capitalist, the transfer income earner – including only retiree, and the family income earner – referring to dependant); with respect to the rural and urban areas, the population consists of a rural and an urban population; and with respect to the province, the population is by province. The final data are sufficiently detailed to the extent that the person in a certain class has the same three marks of social class, area and province. For example, a manager in an urban area in Beijing, and a child in a rural area in Gansu province. The data on the classified population are not directly available. But, these can be easily derived from the 1992 Population Census in China. The data on income levels, however, are difficult to collect. For this reason, a number of information sources are employed to derive the data, and sometimes estimations are made to fill the gaps and to connect

the piecemeal data.

Based on the data, Section 4 calculates Theil's index by the extended method that was developed in Chapter 3, and investigates income inequalities. The overall inequality in the nation consists of the inequality between social classes, the inequality between rural and urban areas, and the inequality between provinces. The overall inequality in each area consists of the inequality between social classes and the inequality between provinces in the area. The overall inequality in each province consists of the inequality between social classes and the inequality between rural and urban areas in the province.

4.2 China's economy

4.2.1 The economic reform

Having suffered a political and economic disaster for nearly 30 years since 1949, China moved toward economic reform in 1978. At the outset, this reform was carefully attempted in rural areas, where the centrally-controlled income distribution mechanism was changed to a new mechanism that allowed farmers to work for themselves and to be paid for their achievement. The reform was greatly welcomed by farmers, and rapidly spread to all the rural areas within the next six years. During the period from 1979-1984, the rural economy grew rapidly. Rural gross output has grown 7.6%, and farmer's per capita income has grown 17.71% per year. The success in the rural areas subsequently drove the entire national economy into the market reform. In 1985, the urban economic reform was started – with changing from a fixed to a flexible wage system. The central government released the power in setting wages to local governments and firms. This reform stimulated the urban economy to grow drastically. During the period from 1985-1988, per capita income in urban areas has grown 16.5% per year. Looking at the reform period from 1978-1994, in total, rural income has grown over nine times, and urban income nearly seven and half times.

As the economic reform went further, however, a number of new problems also emerged. In the initial stage of economic reform, Chinese was mainly interested in the increase of income levels. After a short while, inflation and inequality drew most of their concern. But, while inflation has been under effective control by the government in recent years, the escalating trend of income inequality remains a challenge.

4.2.2 The households

China has the largest population in the world. According to the population census (1990), nearly 28% of the population are juniors aged under 15, 62% are workers aged between 16-59 (16-54 for female), and 10% are senior citizens aged above 60 (55 for female). Among the population above the age of 15, 79% make up the working population, and the rest (21%) comprise the non-working population. The latter includes students, home makers, the urban unemployed, retirees, the disabled and others. The rural unemployed is not observed, and even the urban unemployed is only 0.7% of the population above 15. Workers are ranked according to occupation, with eight basic categories, namely technician, manager, staff, commercial worker, service worker, farmer, industrial worker, and others. Traditionally, managers and staff are categorized into managers, commercial workers and industrial workers into skilled labor, while service workers, farmers and others comprise unskilled labor. Among the working population, 5.3% are technicians, 2.8% are managers, 18.9% are skilled laborers, and 73% are unskilled laborers. Note that farmers are nearly 71% of the working population. During recent years, there have been about one hundred million farmers moving around the country each year to search for higher income jobs.

Since economic reform, two new types of working people have emerged in the market: the capitalists and the self-employed. In China, firms are classified according to ownership into state-owned, collectively owned, other ownership, and private firms. The "other" ownership firms include joint management, stock ownership, foreign funded, overseas Chinese funded, and other units. The private firm is owned privately by domestic Chinese. The capitalist, therefore, refers to the owner of "other" ownership and private firms. In 1993, self-employed workers comprised nearly 5% of the working population, while capitalists made up roughly 0.12% of the working population.[1]

[1]The data on the working population in 1993 are from the 1994 Yearbook of Labour Statistics of China. The number of self-employed is available from Table 7-1, "Number of employed in private enterprises and individual employment both in urban and rural areas by sector", in the yearbook. The number of capitalists is the sum of owners of other ownership and private firms. The number of the owners of private firms is available also from Table 7-1, but the number of the owners of other ownership firms has to be obtained indirectly. The number of the other ownership firms is available from Table 6-1, "Number and wages of staff and workers by sector", in the yearbook. Assuming that the average number of owners in the firms is five, then the total number of the owners is the product of five and the number of other ownership firms.

4.2.3 Fixed assets and investment

Throughout the period of economic reform, China's assets have increased considerably. According to the China Statistical Yearbook (1995), the fixed assets of state-owned firms was about 680 billion Yuan in the year 1978 (according to the price in the year 1993). It has increased, however, to 1770 billion Yuan in the year 1993, with 60% in industry, 3.3% in agriculture, 2.3% in construction, 18% in freight transport and postal telecommunications, 7.3% in trade and catering, and 9.1% in services. The increase was about 100 billion Yuan per year. At present, the state-owned fixed assets account for about 60% of total national fixed assets. In 1994, total investment was 1783 billion Yuan, 91.8% in fixed assets and 8.2% in stock. Fixed assets were 1637 billion Yuan, with 57% in state-owned firms, 16% in collectively-owned firms, 27% in other ownership and private firms. 21% of the total investment was in rural areas.

4.2.4 The sectors

China has a complete production system, which covers all the existing sectors. The first classification according to sectors has six basic sectors: agriculture, industry, construction, freight transport and postal telecommunications, trade and catering, and services. According to the Input-output Table of China (1992), gross output was nearly seven thousand billion Yuan, with 13.3% from agriculture, 54.4% from industry, 7.6% from construction, 3.9% from freight transport and postal telecommunications, 9.3% from trade and catering, and 11.5% from services. The second classification according to sectors includes traditionally 55 sectors. The 1990 input-output table was different from the traditional classifications, which included three tables that were made with respect to the first, second and third classifications, respectively. The input-output table with the second classification has 33 sectors, and the input-output table with the third classification has 118 sectors.

4.2.5 The rural and urban economies

China is probably the only country in the world carrying out an administrative system called "Hukou". The so-called "Hukou" is a hierarchy administration to residence. This administration is specific to rural and urban "Hukou" and to different local "Hukou". The "Hukou" acts as an internal passport in China; it strictly discriminates the holders. Specifically, persons holding rural "Hukou" are identified as farmers who

are restricted to stay and work in rural areas, persons holding urban "Hukou" are identified as urban residents. Moreover, persons holding "Hokou" in a particular location cannot freely exchange these for a "Hukou" in other locations. Over the past decades, the "Hukou" has been one of the most important factors in identifying residence and restricting people's activity. During the period before the economic reform, it was almost impossible for the person without a local "Hukou" to make a living for himself in a particular location. However, the role of "Hukou" has been diminishing since the economic reform.

In China, rural and urban areas are classified according to the proportion of residents who hold rural or urban "Hukou". The urban areas involve cities and towns in which the proportion of people with urban "Hukou" meet government regulations. The rest of the country is the rural area. According to the population census (1990), 80% of China's population hold the rural "Hukou", and 20% the urban "Hukou". Yet, the statistical data also revealed that agriculture contributed only 27% to China's GDP, and that per capita income of urban households was twice times that of the households of farmers. [2]

4.2.6 The regional economies

Because of its size, China consists of a number of regional economies. Administratively, China has 30 provinces, each of which is a complete economy. These provincial economies are under the control of central and local governments. Since the economic reform, the central government has been releasing more and more of its power to local governments. Economic development is unbalanced across the provinces. Along the east coast, there are ten provinces: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangshu, Zhejiang, Fujian, Sandong, and Guangdong. In 1994, this part was home to 36.5% of China's population and contributed 55.6% to national GDP.[3] Per capita GDP for the east coast was 5720 Yuan. In the middle part of the country, there are nine provinces: Sanxi, Neimeng, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan and Hubei. This part was home to 35.6% of China's population and contributed 27.6% to national GDP. Per capita GDP in the middle part was 2913 Yuan. The western part has the remaining eleven provinces: Guangxi, Hainan, Sichuan, Guizhou, Yunnan, Tibet, Shanxi, Gansu, Qinghai, Ningxia, and Xinjiang. This part was home to

[2]The data sources are Table 2-10, "Gross national products and its indices", and Table 9-1, "Improvement in people's material and cultural life", in the 1995 China Statistical Yearbook.

[3]All the data in this section are from the 1995 China Statistical Yearbook.

27.9% of China's population and contributed 16.8% to national GDP. Per capita GDP in the western part was 2260 Yuan. In general, the eastern, middle and western parts are referred to, respectively, as developed, less-developed and under-developed zones.

4.2.7 Trade

Two kinds of trade exist for each province. One is trade with the rest of China, another is trade with the rest of the world. In China, trade between provinces is relatively more important than international trade. There are eleven provinces with significant trading relations outside of China. Input-output tables (1992) include the separate information on the trade of these eleven provinces to the rest of China and to the rest of the world. According to these tables, the trade of each of theses provinces with the rest of China is much greater than with the rest of the world. Total volume of exports of the eleven provinces to the rest of China is nearly five times that of the total volume of exports of the eleven provinces to the rest of the world; the total volume of imports of the eleven provinces from the rest of China is nearly eleven times that of the total volume of imports of the eleven provinces from the rest of the world.

4.3 The data

4.3.1 The population data

The calculation of Theil's index requires two sets of data, which are the population and the income. This research requires the population data with respect to the eight social classes defined in Chapter 2, with respect to rural and urban areas, and with respect to provinces. These data are directly available from the China Population Census (1990), except for the number of capitalists and self-employed.

The data on the classes of unskilled, skilled, manager and technician are obtained from the China Population Census Vol. 2 (1990)[4], which presents the data originally with eight occupations: technician, manager, staff, business, servant, farmer, worker and others. I aggregate staff, business and worker into the skilled class, and aggregate

[4]Table 6-15 "City Working Persons by Two Digits Classification of Occupation and Province", Table 6-16 "Town Working Persons by Two Digits Classification of Occupation and Province", and Table 6-17 "County Working Persons by Two Digits Classification of Occupation and Province" in the China Population Census Vol. 2 (1990). Among the three, the first two are for urban data, the third is for rural data.

servant, farmer and others into the unskilled class. The data on retirees are available from the other three tables in the China Population Census Vol. 2 (1990),[5] among which, the first two are for urban data, the third is for rural data. The data on family-income dependants can be obtained by collecting relevant items in the China Population Census (1990), or by simply extracting the number of laborers and retirees from the total population. This research uses the second way. In addition, because the population census data are in the year 1990, they are adjusted into the year 1992 according to the population in 1992 in China from the source in Statistical Yearbook of China, 1993.[6]

The data on the number of capitalists and self-employed are collected separately from another source, the China Labour Statistical Yearbook (1993).[7] Instead of presenting the data on capitalist and self-employed directly, the China Population Census (1990) already has the data included in the labor categories. Therefore, to make the data consistent, a number of laborers corresponding to the number of capitalists and self-employed are extracted out of the labor categories. Neither the China Population Census (1990) nor the China Labour Statistical Yearbook (1993) provides information on the occupation of capitalists and the self-employed. It remains unclear how many of the capitalists and self-employed are either technicians, managers, skilled or unskilled. This research simply assumes that all the capitalists and self-employed come from the skilled class. The final data are presented in Table 4.1.

4.3.2 The income data

The income data are required to correspond to the population categories. As sources that include sufficient information on personal income are rare, collecting income data is more difficult than collecting population data. This chapter has had to use as many information sources as possible to derive the data. Sometimes, assumptions have been made to fill the data gaps. However, the assumptions have been made reasonably and the data are estimated consistently. The data on income levels must also be classified:

[5]Table 6-28 "City Non-working Persons by Province", Table 6-29 "Town Non-working Persons by Province", and Table 6-30 "County Non-working Persons by Province" in the China Population Census Vol. 2 (1990).

[6]Table 3-3 "Total Population and Birth Rate, Death Rate and Natural Growth Rate of Population by Province, 1992" in the Statistical Yearbook of China (1993).

[7]Table 6-3 "Urban Employment in Private Enterprises and Individual Households by Province" and Table 6-4 "Rural Employment in Private Enterprises and Individual Households by Province" in the China Labour Statistical Yearbook (1993).

Table 4.1 **1992 China Population (estimated)**

The Eastern Part

		Shanghai	Beijing	Tianjin	Guangdong	Zhejiang	Liaoning	Jiangsu	Fujian	Hebei	Sandong
1	Rural unskilled	1053773	866858	1107746	17959349	11576084	9326260	24566410	9612977	25642777	34129906
2	Rural skilled	1575239	407383	222743	2010768	3667196	845708	6859832	1524030	42559	52544
3	Rural manager	78436	50628	26029	129161	148838	130956	574097	80137	147691	225585
4	Rural technician	164136	84921	53553	412357	398194	376870	998949	363176	565004	835486
5	Rural self-employed	104140	160865	95743	1173421	1456627	439673	1101917	400015	1653653	2373151
6	Rural capitalist	4389	599	6649	27492	16911	6364	6507	7085	14784	13390
7	Rural retiree	148256	33114	17375	281656	178704	167245	483125	140144	273196	341026
8	Rural dependant	1410663	1323908	1270754	19272202	11713375	8333590	19620942	12378061	22353882	24584733
	Rural population	4539032	2928276	2800592	41266406	29155929	19626666	54211779	24505625	50693546	62555821
1	Urban unskilled	584655	823183	720507	4256586	2503955	2645268	1927493	947115	1973178	6645257
2	Urban skilled	3298110	2460982	2156565	6199681	3870447	6220334	4975721	1654209	3419409	5251203
3	Urban manager	282544	376242	191158	471232	262927	696926	636791	130018	358758	457677
4	Urban technician	887702	976299	594502	1474986	915195	1597977	1275515	492557	1024697	1502633
5	Urban self-employed	79090	117804	46516	763701	283895	472894	210288	242530	183928	296721
6	Urban capitalist	11601	15360	9342	73095	17086	19782	16385	54533	6093	16080
7	Urban retiree	1350286	724366	510376	1049934	655528	1592882	1110513	329770	542809	731107
8	Urban dependant	2416981	2597535	2170440	9692481	4695051	7288136	4745513	2803633	4548201	8643502
	Urban population	8910969	8091771	6399406	23981696	13204084	20534199	14898219	6654365	12057073	23544180
	Dependency ratio	0.4	0.55	0.6	0.8	0.63	0.64	0.54	0.95	0.75	0.63
	1992 Total population	13450000	11020000	9200000	65250000	42360000	40160000	69110000	31160000	62750000	86100000

Table 4.1 (continued)

1992 China Population (estimated)

The Middle Part

		Heilongjiang	Jilin	Sanxi	Neimeng	Jiangxi	Hunan	Hubei	Anhui	Henan	China
1	Rural unskilled	8178501	6975122	9270061	6707771	14856940	26863862	21130853	26467638	41049622	437155466
2	Rural skilled	511357	320164	557680	275091	956758	1195240	902474	914910	1025825	26647818
3	Rural manager	108726	58740	93304	61229	112621	154599	151391	159854	254606	3379362
4	Rural technician	351239	241584	338984	240144	445507	602401	528277	547337	993937	11472709
5	Rural self-employed	152295	162505	587676	193310	590272	782226	654851	773824	901166	17275375
6	Rural capitalist	380	1004	11717	1662	3256	5846	1387	3019	8231	167139
7	Rural retiree	165499	57175	144714	60748	202132	335698	168436	194696	320295	5043517
8	Rural dependant	9307183	6803037	10197038	6510231	13998329	21429096	16221241	18869465	30558240	359829850
	Rural population	18775180	14619331	21201174	14050186	31165815	51368968	39758910	47930743	75111922	860971236
1	Urban unskilled	1975755	1100966	1084208	1024358	1271044	2024164	2897862	1750715	2401093	50493026
2	Urban skilled	4361251	2854180	2376805	1954824	1875904	2801376	4361328	2680352	3497060	80823483
3	Urban manager	524770	295529	278229	201952	193682	323793	438279	283010	417715	8352688
4	Urban technician	1240598	858205	729725	617411	592710	926929	1288475	758248	1074305	23914704
5	Urban self-employed	464219	336786	154958	230212	312093	367627	279548	409499	368858	7402016
6	Urban capitalist	9230	4778	4615	4117	3754	6902	4995	3326	3943	331993
7	Urban retiree	982098	616772	324393	346321	384179	620861	785556	494470	566840	17088007
8	Urban dependant	7746814	4633456	3635792	3640621	3330819	4229392	5985025	4029636	5168228	116322296
	Urban population	17304735	10700672	8588725	8019816	7964185	11301044	16041068	10409256	13498042	304728213
	Dependency ratio	0.9	0.82	0.87	0.85	0.79	0.69	0.66	0.65	0.68	0.69
	1992 Total population	36080000	25320000	29790000	22070000	39130000	62670000	55800000	58340000	88610000	1165700000

Table 4.1 (continued)

1992 China Population (estimated)

The Western Part

		Hainan	Xinjiang	Tibet	Qinghai	Ningxia	Guangxi	Shanxi	Yunnan	Sichuan	Gansu	Guizhou
1	Rural unskilled	2314405	4781473	894046	1651373	1719946	19173645	13474257	17370544	53560310	10219588	14653369
2	Rural skilled	203049	221014	43601	100307	29967	147022	344610	354377	1116132	59693	160545
3	Rural manager	16845	48400	12863	14611	12556	90158	74904	84298	172154	54628	51317
4	Rural technician	78775	195241	49155	79054	48059	397080	345036	376764	925725	198365	237399
5	Rural self-employed	66887	174221	14862	28951	48185	545070	407374	397675	1374038	264199	196583
6	Rural capitalist	894	1479	1	361	469	3660	4333	1394	7410	2280	4186
7	Rural retiree	108280	125893	8249	13518	11665	121342	124473	162615	543396	37435	73417
8	Rural dependant	2428165	5123878	994629	1515380	1732716	16810368	11942893	13859138	30286707	7213054	11766952
	Rural population	5217300	10671599	2017406	3403555	3603563	37288345	26717880	32606805	87985872	18049242	27143768
1	Urban unskilled	256836	538664	33059	112351	138315	889196	1023015	1145500	5394754	908238	1495736
2	Urban skilled	282638	1156415	43655	323520	333784	1485203	1946758	1309144	5281343	1248429	1142853
3	Urban manager	37609	145341	8748	37075	38742	191802	233267	132736	426881	149210	130045
4	Urban technician	125216	431536	25424	106240	121541	524734	708435	499168	1702855	413525	427361
5	Urban self-employed	91127	185482	25863	40952	27034	313935	179326	142059	483389	105429	186253
6	Urban capitalist	14529	2900	16	563	1376	8002	3030	1331	7721	2844	4664
7	Urban retiree	62107	328993	10706	53891	56073	325262	387123	306219	1385758	194864	257950
8	Urban dependant	772638	2349076	115124	531853	549764	2773536	2851035	2176994	7311433	2068218	2821369
	Urban population	1642700	5138407	262595	1206445	1266629	6511670	7331989	5713151	21994134	5090757	6466231
	Dependency ratio	0.87	0.9	0.95	0.8	0.88	0.81	0.77	0.72	0.52	0.67	0.77
	1992 Total population	6860000	15810000	2280000	4610000	4870000	43800000	34050000	38320000	109980000	23140000	33610000

according to rural and urban areas, to provinces, and to social classes. The detailed steps in collecting the income data are as follows:

The first step is to collect data on urban wages. Normally, the wage includes two parts: the money wage and the social insurance and welfare funds. The China Labour Statistical Yearbook (1993) provides data on money wage by province,[8] and the data on the social insurance and welfare funds of staff and workers.[9]

Urban wages represent overall data, which need to be further separated by occupation, as information authorities in China usually collect the wage data regarding sector rather than occupation. A special survey in the Yearbook of Labour Statistics of China (1993) provided a section regarding occupational wages. According to the information, the skilled wage matches the average wage, the unskilled wage equals 0.584 times the average wage, the manager's wage equals 1.035 times the average wage, and the technician's wage equals 1.052 times the average wage. [10] Assuming these ratios are applicable to all provinces, I can then separate the provincial data on urban wage by occupation.

So far, the incomes of capitalists and the self-employed have not been screened well by the Chinese government. Formal information from the government on capitalist and the self-employed income is rare. However, small studies have frequently involved this issue. Most of the studies estimate that capitalist income could be around ten times, and self-employed income could be around four times, that of a skilled worker.[11] In this research, I borrow the two ratios to determine capitalist and self-employed incomes in the urban areas.

[8]Table 1-65 "Number and Total Wage Bill of Staff and Workers by Province" in the China Labour Statistical Yearbook (1993).

[9]These are presented in four other separate tables, Table 9-20 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers in State-owned Units by Province", Table 9-31 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers in Urban Collectively-owned Units by Province", Table 9-34 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers in Units of Other Ownership by Province", and Table 9-36 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers in Foreign Funded Enterprises by Province". The average of these tables is the total social insurance and welfare funds of staff and workers by province.

[10]In the Yearbook of Labour Statistics of China (1993), Table 7-13 "Increase Rate of Wages of 14 Cities' and Counties' Staff and Workers" gives the average wages by occupation in October, 1992 as follows: unskilled 150.62 Yuan, skilled 257.87 Yuan, technician 271.22 Yuan, and manager 266.87 Yuan. In other words, the technician's wage is 1.016 over the manager's wage, 1.052 over the skilled, and 1.8 over the unskilled. Since the average of the wages is 257.89 Yuan, it can be seen that the unskilled worker's wage equals 0.584 of the average, the skilled worker's wage equals the average, the manager's wage equals 1.035 of the average, and the technician's wage equals 1.052 of the average.

[11]See, Zhong (1989), Yang and Shao (1989), Chu (1990), Li (1990), Luo (1989), and Zhao (1992).

The data on retired income in urban areas are directly available from the Yearbook of Labour Statistics of China (1993).[12]

The income of dependants is obtained by assuming that all families have the same composition in urban areas; in other words, dependants are equally allocated to the people on whom they depend. Since income is shared within the family, a dependant will get a higher income if his income comes from working persons who earn more. If the numbers were known of how many dependants are dependent on which classes of people, it would be easy to derive their income. Unfortunately, this kind of information does not exist. Therefore, by assuming that dependants are spread equally among their families, and further by calculating a unique dependency ratio, which is the ratio of dependants to primary income earners,[13] this research obtains the dependant's income by dividing the average of the primary income earners' incomes over the dependency ratio. The primary income earners have the net income left after sharing their primary income with the family. At the stage after the family income distribution, the average of the net incomes of the primary earners is the same amount as the income received by the dependants.

The income of rural labor is not directly available, because economic data in rural areas are usually surveyed with respect to household rather than with respect to labor. I have to estimate the data from relevant information sources. The Yearbook of Survey on Rural Households (1992) includes the data on national rural households' income by education in the year 1991. According to experience, educational level is significantly related to occupation in rural areas. Therefore, following the general way to connect one's education level with his occupation in China, I define the occupations of rural labor by education as follows: those with educational years fewer than six belong to the unskilled, those have between 7-12 years belong to the skilled, and those having above 12 years belong to the manager and the technician. In this way, rural labor's income can be split by occupation, even though the data are still national macro data

[12]In the Yearbook of Labour Statistics of China (1993), there are four tables used: Table 9-25 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers under Termination, Retirement and Resignation in State-owned Units by Province", Table 9-32 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers under Termination, Retirement and Resignation in Urban Collectively owned Units by Province", Table 9-35 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers under Termination, Retirement and Resignation in Units of Other Ownership by Province", and Table 9-37 "Composition of Total Social Insurance and Welfare Funds of Staff and Workers under Termination, Retirement and Resignation in Foreign Funded Enterprises by Province". The weighted averages of the incomes in these tables are calculated to get the retired income in urban areas.

[13]In this research, retirees are not supposed to afford any dependants.

rather than provincial data. The survey gives labor composition by education, but it does not include data on the corresponding income.[14] However, the survey presents the data on household income by labor education.[15] Using this information roughly as labor income by education,[16] it can be derived that in rural areas the technician's and manager's income are the same, which is 1.37 times more than the average, 1.34 times more than the skilled, and 1.59 more than the unskilled. This estimation is consistent with the common recognition that in rural area the income differences between technician and manager and between skilled and unskilled are small, but income difference between the technician and manager and the skilled and unskilled is large. The reasons behind these are that rural technician and manager are paid still according to urban wage system, while unskilled and skilled take similar operation for production. By applying these macro ratios at national level to provinces, I break down the rural income by occupation or skill and by province.

The income of rural capitalist and self-employed are estimated by assuming that rural capitalist earns ten times over rural skilled and rural self-employed earns four times over rural skilled, following the way in estimating the incomes of urban capitalist and self-employed. The rural retiree receives as same income as urban retiree. The rural dependant income equals to the rural households' mean income, which is directly available from the China Statistical Yearbook (1993).[17] The final data are presented in Table 4.2.

4.4 Personal income distribution

4.4.1 The overall inequality

As China is a socialist country, China's inequality has been an attractive topic: does China have less inequality compared to other developed or less developed countries? Many economists and analysts conjecture that China still has less inequality. Two

[14]Table 3-2 "Rural Labours' Quality by province" in the survey.

[15]Table 2-5 "The Main Indicators of Rural Households by Labor's Education" in the survey.

[16]As a result, unskilled income is 611.67 Yuan, skilled 725.83 Yuan, and Manager's and Technician's 971.56 Yuan. The average income of rural households, moreover, is 708.55 Yuan in 1991. Assume that technician's and manager's income are the same, their income is thus 1.37 times more than the average, 1.34 times more than the skilled, and 1.59 more than the unskilled. The skilled income is 1.19 times more than the unskilled.

[17]Table 8-23 "Net Income of Peasant Household Per Capita by Province" in China Statistical Yearbook (1993).

Table 4.2

Chinese Income in 1992

The Eastern Part

		Shanghai	Beijing	Tianjin	Guangdong	Zhejiang	Liaoning	Jiangsu	Fujian	Hebei	Sandong
1	Rural unskilled	1914	1352	1126	1125	1169	856	912	846	587	691
2	Rural skilled	2279	1610	1340	1339	1392	1019	1086	1008	698	822
3	Rural manager	3050	2154	1793	1792	1862	1363	1454	1348	934	1100
4	Rural technician	3050	2154	1793	1792	1862	1363	1454	1348	934	1100
5	Rural self-employed	9118	6439	5362	5358	5566	4076	4346	4030	2793	3289
6	Rural capitalist	22794	16097	13404	13394	13916	10189	10865	10076	6984	8223
7	Rural retiree	3416	3128	2816	3105	2858	2675	2662	2403	2878	2635
8	Rural dependant	2226	1572	1309	1308	1359	995	1061	984	682	803
	Rural mean income	2433	1827	1429	1372	1524	1026	1090	998	720	853
1	Urban unskilled	2071	1562	1125	1084	801	1071	1290	1029	1039	672
2	Urban skilled	3545	2675	1927	1856	1372	1834	2208	1762	1778	1151
3	Urban manager	3669	2769	1994	1921	1420	1898	2285	1824	1840	1191
4	Urban technician	3729	2814	2027	1953	1443	1930	2323	1854	1870	1211
5	Urban self-employed	14174	10729	7716	7418	5494	7320	8830	7032	7115	4598
6	Urban capitalist	35434	26822	19289	18546	13735	18299	22074	17580	17787	11496
7	Urban retiree	3416	3128	2816	3105	2858	2675	2662	2403	2878	2635
8	Urban dependant	3369	2464	1776	1562	1166	1618	1993	1502	1545	916
	Urban mean income	3539	2719	1935	1890	1375	1876	2183	1910	1718	1031
	1992 overall mean inc	3166	2482	1781	1562	1477	1461	1326	1193	912	901

Table 4.2 (continued)

Chinese Income in 1992

The Middle Part

		Heilongjiang	Jilin	Sanxi	Neimeng	Jiangxi	Hunan	Hubei	Anhui	Henan	China
1	Rural unskilled	816	694	539	578	660	636	583	494	506	649
2	Rural skilled	972	826	642	688	786	757	694	588	602	1082
3	Rural manager	1300	1106	859	921	1052	1012	929	786	806	1197
4	Rural technician	1300	1106	859	921	1052	1012	929	786	806	1110
5	Rural self-employed	3887	3305	2568	2753	3146	3027	2777	2351	2408	3461
6	Rural capitalist	9718	8264	6420	6881	7864	7567	6943	5878	6021	9778
7	Rural retiree	2462	2399	2602	2403	2130	2391	2179	2290	2439	2578
8	Rural dependant	949	807	627	672	768	739	678	574	588	780
	Rural mean income	938	794	664	670	777	736	673	569	577	795
1	Urban unskilled	851	863	964	814	825	990	787	838	922	934
2	Urban skilled	1457	1478	1651	1394	1413	1696	1348	1434	1578	1737
3	Urban manager	1508	1529	1709	1443	1462	1756	1395	1484	1633	1819
4	Urban technician	1532	1555	1737	1466	1486	1784	1418	1509	1660	1827
5	Urban self-employed	5822	5908	6585	5564	5664	6786	5388	5738	6316	6648
6	Urban capitalist	14556	14770	16463	13910	14161	16965	13470	14346	15789	18459
7	Urban retiree	2462	2399	2602	2403	2130	2391	2179	2290	2439	2661
8	Urban dependant	1260	1288	1466	1195	1157	1410	1150	1178	1322	1432
	Urban mean income	1488	1538	1628	1406	1426	1685	1295	1456	1541	1686
	1992 overall mean inc	1201	1109	942	937	909	907	852	727	724	1028

Table 4.2 (continued)

Chinese Income in 1992

The Western Part

		Hainan	Xinjiang	Tibet	Qinghai	Ningxia	Guangxi	Shanxi	Yunnan	Sichuan	Gansu	Guizhou
1	Rural unskilled	725	636	714	519	508	630	481	531	545	421	435
2	Rural skilled	863	758	850	617	605	750	572	633	649	501	518
3	Rural manager	1155	1014	1137	826	810	1003	766	847	869	670	693
4	Rural technician	1155	1014	1137	826	810	1003	766	847	869	670	693
5	Rural self-employed	3453	3031	3400	2470	2421	2998	2290	2531	2597	2003	2073
6	Rural capitalist	8632	7578	8499	6175	6052	7496	5724	6328	6492	5007	5181
7	Rural retiree	2279	2760	3956	3533	2741	2519	2422	2825	2300	2905	2394
8	Rural dependant	843	740	830	603	591	732	559	618	634	489	506
	Rural mean income	862	762	820	597	587	723	559	610	624	481	487
1	Urban unskilled	1382	1253	1734	1301	1143	1038	972	1091	821	1026	642
2	Urban skilled	2367	2145	2969	2228	1957	1778	1663	1868	1405	1756	1100
3	Urban manager	2450	2220	3072	2305	2026	1840	1721	1934	1455	1818	1139
4	Urban technician	2490	2256	3123	2343	2059	1870	1750	1965	1478	1848	1157
5	Urban self-employed	9467	8550	11894	8885	7831	7130	6641	7482	5624	7033	4403
6	Urban capitalist	23667	21375	29735	22213	19578	17825	16604	18704	14060	17583	11008
7	Urban retiree	2279	2760	3956	3533	2741	2519	2422	2825	2300	2905	2394
8	Urban dependant	2042	1830	2159	1957	1756	1460	1445	1536	1135	1488	861
	Urban mean income	2650	2200	3398	2328	1972	1866	1660	1791	1332	1688	1048
	1992 overall mean inc	1290	1230	1117	1050	947	893	796	786	766	746	595

studies used the Gini coefficient to investigate the overall inequality for China. The special research project conducted by Griffin et al. (1994) found that the Gini coefficient for China was 0.38 in 1988. Griffin et al. compared their results with other Asian developing countries and concluded that overall inequality in China was low.

Based on the data collected in the last section, this research now measures income inequality by Theil's index. The results are presented in Table 4.3. The figure in row 33 and column 5 indicates a very low value of Theil's index regarding the overall inequality for China: 0.0873 in 1992. This result is consistent with the conclusion in other research that income inequality in China is not high until now. Moreover, the overall inequality is composed of the following: 43% by the inequality between social classes in row 34 and column 6, 24% by the inequality between provinces in row 35 and column 5, and 33% by the inequality between rural and urban areas in row 33 and column 7. The sum of the first two is, 67%, the contribution by the inequality in rural and urban areas in row 33 and column 6.

From Table 4.2, the small difference in income between persons can be seen directly. In rural areas, the highest income, the rural capitalist's income, is 15 times that of the lowest income, that earned by the rural unskilled. In urban areas, the figure is nearly 20 times. With respect to each social class, the income in urban areas is higher than in rural areas. The urban mean income, moreover, is over two times higher than the rural mean income. Among the provinces, Shanghai has the highest income, while Guizhou has the lowest income. The former has income over five times higher than that of the latter.

4.4.2 Inequalities in rural and urban areas

As discussed in Section 2, the distinction between rural and urban economies in China is so stark that income distribution in rural and urban areas has a marked difference. Most research, therefore, studies personal income distribution separately with respect to rural and urban areas.

Some research found that income inequality in rural areas was higher than in urban areas. The conclusion is the opposite of the situation in other developing countries in Asia.[18] The State Statistical Bureau (1987) found a Gini coefficient in rural areas in 1987 of 0.236. Zhu and Wen (1990) calculated a Gini coefficient in rural areas of 0.3014 in 1988. Griffin et al. (1994) found that the Gini coefficients were 0.3338

[18]see Griffin et al. (1992)

Table 4.3 **Income Inequality in the Observed Economy**

		Rural inequality	Urban inequality	Across areas	Between areas	Provincial inequality	Across areas	Between areas	Per capita final uses
		1	2	3	4	5	6	7	8
Shanghai	1	0.0323	0.0209	0.0239	0.0062	0.0301	79%	21%	8529
Tianjin	2	0.0521	0.0256	0.0321	0.0039	0.0359	89%	11%	4535
Beijing	3	0.0553	0.0328	0.0372	0.0058	0.043	86%	14%	6378
Sandong	4	0.0484	0.0445	0.0472	0.0016	0.0488	97%	3%	2467
Jiangshu	5	0.0294	0.0297	0.0295	0.0221	0.0515	57%	43%	2903
Zhejiang	6	0.0555	0.0515	0.0543	0.0005	0.0548	99%	1%	2875
Liaoning	7	0.0333	0.0401	0.0378	0.0187	0.0565	67%	33%	3204
Guangdong	8	0.0392	0.0662	0.0512	0.0054	0.0566	90%	10%	3441
Fujian	9	0.0245	0.0905	0.0471	0.0189	0.066	71%	29%	2556
Hebei	10	0.0459	0.0327	0.0411	0.0342	0.0753	55%	45%	1853
Heilongjiang	11	0.0157	0.0436	0.0323	0.0114	0.0437	74%	26%	2655
Hubei	12	0.0252	0.0355	0.0297	0.0218	0.0516	58%	42%	1376
Jianxi	13	0.028	0.0585	0.0377	0.016	0.0537	70%	30%	1560
Jilin	14	0.0184	0.0455	0.0343	0.0235	0.0578	59%	41%	2369
Hunan	15	0.0257	0.0523	0.0346	0.0297	0.0643	54%	46%	1522
Neimeng	16	0.0233	0.0461	0.0357	0.0296	0.0653	55%	45%	0
Henan	17	0.023	0.0455	0.0303	0.0398	0.0701	43%	57%	1405
Anhui	18	0.0267	0.058	0.0379	0.0391	0.077	49%	51%	1192
Sanxi	19	0.0431	0.0326	0.0379	0.0422	0.0801	47%	53%	2735
Guizhou	20	0.0167	0.0628	0.0323	0.0259	0.0582	56%	44%	1062
Shichuan	21	0.0276	0.0467	0.0343	0.0257	0.06	57%	43%	1477
Guangxi	22	0.0231	0.0682	0.0371	0.0363	0.0733	51%	49%	1535
Yunnan	23	0.0249	0.0448	0.0316	0.0488	0.0804	39%	61%	646
Shanxi	24	0.0275	0.0393	0.0328	0.0587	0.0916	36%	64%	1721
Xinjiang	25	0.0325	0.0496	0.0424	0.0601	0.1025	41%	59%	3708
Ningxia	26	0.024	0.0372	0.0312	0.0771	0.1082	29%	71%	2182
Gansu	27	0.0262	0.0407	0.0334	0.0804	0.1138	29%	71%	1517
Tibet	28	0.0181	0.1045	0.0484	0.0821	0.1305	37%	63%	0
Hainan	29	0.0267	0.1082	0.0668	0.0648	0.1316	51%	49%	0
Qinghai	30	0.0232	0.0461	0.0365	0.0977	0.1342	27%	73%	2257
Acroos provinces		0.0324	0.0455	0.038	0.0284	0.0665	57%	43%	
Between provinces		0.0243	0.0163	0.0208		0.0208	100%	0%	
Theil's inequality		0.0567	0.0618	0.0589	0.0284	0.0873	67%	33%	
Across provinces		57%	74%	65%	100%	76%	43%		
Between provinces		43%	26%	35%	0%	24%			

in rural areas and 0.233 in urban areas in 1988. Wang (1995) calculated the Gini coefficients for China, which were 0.331 in rural areas, and 0.242 in urban areas in 1993.

Most of these studies argued that the differences in inequality between rural and urban areas resulted from the fact that the income sources that were more unequally distributed had more shares in rural areas than in urban areas. According to Griffin et al. (1994), the inequality in rural areas resulted mainly from farmer's non-production rather than production income, whereas the small difference between staff and worker's money income resulted in the low inequality in urban areas.

The results in this research differ from the others. I found that China had a similar situation of inequality as found in other developing countries in Asia, that the inequality in rural areas was nearly the same or slightly lower than in urban areas. In Table 4.3, the inequality in rural areas is 0.0567 in row (33) and column (1), and the inequality in urban areas is 0.0618 in row (33) and column (2). In particular, the inequality in rural areas is more than in urban areas in only six of the ten provinces in the developed eastern part, and in one of the nine provinces in the less-developed middle part. The inequality in rural or in urban areas consists of the inequality between social classes and the inequality between provinces. The results show that the inequality between social classes is lower in rural areas than in urban areas, while the inequality between provinces is higher in rural areas than in urban areas. The inequality between social classes in rural areas is 0.0324 in row (31) and column (1), which is 14% lower than the one in urban areas, which is 0.0455 in row (31) and column (2); the inequality between provinces in rural areas is 0.0243 in row (32) and column (1), which is 1.49 times over the one in urban areas, which is 0.0163 in row (32) and column (2).

4.4.3 Inequality between rural and urban areas

It has been a popular argument that inequality between rural and urban areas is significant and rigid in China because of the greatly unbalanced development of rural and urban economies. Wang et al. (1995) compared the income means between rural and urban areas from 1978 to 1994. They found that income inequality between rural and urban areas in China had gone through two stages. In the first stage, between 1978-1985, the inequality between rural and urban areas had decreased. The reason was that rural economic reform caused farmers' income to increase faster than that of

the urban-dweller during the period. The period from 1985 to 1994 was the time for urban economic reform. In this stage, urban-dwellers' income grew faster than that of the farmers, which expanded the income difference between rural and urban areas. So far, the difference is increasing.

This research observed the income difference between rural and urban areas. In Table 4.2, urban income was over two times higher than rural income in China. Except for Zhejiang (where rural income is higher than urban income), all other provinces reported higher urban income than rural income. Theil's index in Table 4.3 shows that the inequality between rural and urban areas is 0.0284 for the nation in row (33) and column (4), which is the average of the Theil's inequalities between rural and urban areas in all provinces. Moreover, column 7 shows that the inequality between rural and urban areas contributes 33% of the overall inequality in the nation, and also large proportions in provinces, especially in the less- and least developed provinces.

4.4.4 Inequalities in the provinces

Section 2 mentioned that China had 30 administrative provinces, each of which was a complete regional economy; according to their level of economic development, these provinces were usually referred to as the developed east-coast part, the less-developed middle part and the under-developed western part. Income inequalities in the provinces and economic zones are different.

The inequality in each province is investigated frequently, because each province is a relatively independent economy. Comparable with the study on income inequality for the national economy, almost all the studies for each province have investigated income inequality with respect to rural and urban areas. Zhu and Wen (1990) and Griffin, et al. (1994) calculated the rural Gini coefficients in 1988 for each province. The results of their research and this research are listed jointly in decreasing order of the levels of per farmer income in Table 4.4. The data show no systematic relationship between income inequality and economic development in rural areas. The income inequality in urban areas has not been studied as much as the income inequality in rural areas by province. Griffin et al. (1994) calculated the urban Gini coefficients in ten provinces. They also did not find any relationships between the inequality in urban areas and economic development. They finally argued that the inequality might be related to income structures or other unknown factors.

In this research, the overall income inequality in China could be decomposed into

Table 4.4 **Inequalities in Rural Area in China**

	Per capita income of farmers in 1988	Gini coefficient in 1988 *	Gini coefficient in 1988 **	Theil's index in 1992 ***
Shanghai	1301	0.222	0.215	0.0323
Beijing	1063	0.305	0.233	0.0553
Zhejiang	902	0.286	0.298	0.0555
Tianjin	891	0.394	0.256	0.0521
Guangdong	809	0.306	0.305	0.0392
Jiangsu	797	0.383	0.299	0.0294
Liaoning	700	0.33	0.3	0.0333
Jilin	628	0.354	0.264	0.0184
Fujian	613	0.29	0.218	0.0245
Sandong	584	0.285	0.267	0.0484
Hainan	567	0.276	0.283	0.0267
Heilongjiang	553	0.368	0.294	0.0157
Hebei	547	0.293	0.289	0.0459
Hunan	515	0.255	0.212	0.0257
Neimenggu	500	0.339	0.293	0.0233
Hubei	498	0.231	0.229	0.0252
Xinjiang	497		0.323	0.0325
Qinghai	493	0.313	0.325	0.0232
Jiangxi	488	0.23	0.201	0.028
Anhui	486	0.249	0.207	0.0267
Ningxia	473	0.273	0.315	0.024
Sichuan	449	0.265	0.241	0.0276
Sanxi	439	0.32	0.275	0.0431
Yunnan	428	0.287	0.259	0.0249
Guangxi	424	0.291	0.279	0.0231
Shanxi	404	0.289	0.263	0.0275
Henan	401	0.299	0.25	0.023
Guizhou	398	0.295	0.234	0.0167
Tibet	374		0.279	0.0181
Ganshu	340	0.263	0.248	0.0262

Sources:

* Griffin, et al. (1994)

** Zhu and Wen (1990)

*** this research.

three parts by Theil's index: namely the income inequality between social classes, the income inequality between rural and urban areas, and the income inequality between provinces. In each province, the overall income inequality consists of the income inequality between social classes and between rural and urban areas only. Studies like Griffin et al. (1994), which apply the Gini coefficient, are unable to do this. The results of my research are presented in columns (3), (4) and 5 in Table 4.3, respectively. Comparing the figures in column (3) and (4), it can be found out that the income inequality between social classes is higher than the income inequality between rural and urban areas in all developed provinces, in six of the nine less developed provinces, and in four of the eleven least developed provinces. Roughly speaking, there is a negative relationship between the income inequality between areas and their economic development, a positive relationship between overall income inequality and the income inequality between areas, and the income inequality between social classes is irrelevant with the development of the province. The result, therefore, showed that the difference in the overall income inequality among provinces was approached mainly by the difference in the income inequality between areas among provinces.

4.4.5 Inequality between provinces

The existing studies provide few numerically explicit results on the inequality between provinces. Wang et al. (1995) compared the income levels in rural area between the eastern, the middle and the western parts, and found out that the ratio was 2.58 : 1.16 : 1 in 1992. Further, they compared income levels in rural areas between provinces in each of the three parts. They concluded that there was a big difference in income between the eastern part and the middle and western part, a small difference in income between the middle and the western parts. There was a big difference in income between the provinces within the eastern part and a small difference in income between the provinces within the middle and the western part. With respect to the difference in urban income between regions, they found out that the ratio of income in the three parts was 2.13 : 0.89 : 1, and made a similar conclusion as they did for rural income. Their analysis was roughly done, as they used the income of a certain province in each part to represent the income of the part. Yang (1992) calculated the relative mean deviation of per capita GNP in 1989 with respect to the eastern, the middle and the western part, and the provinces in the parts. He arrived at a similar conclusion as Wang et al. (1995). Wei (1992) calculated the weighted relative mean

deviation of per capita national income, and also obtained a similar conclusion. All these studies were unable to justify the income inequality between provinces in China.

The results in this research directly reveal similar conclusions. Table 4.2 shows that the eastern part is richer than the middle and the western part, and that the middle and the western parts are close in income. Eight of the ten provinces in the eastern part, two of the nine provinces in the middle part and four of the eleven provinces in the western part have incomes above the mean income in the nation. In the eastern part, income distance is large. The highest income in Shanghai is over three and a half times higher than the lowest income in Sandong. In the middle part, the income distance is small. The highest income in Heilongjiang is over one and a half times higher than the lowest income in Henan. In the western part, the income difference is average. The highest income in Hainan is over two times higher than the lowest income in Guizhou. Although it reaches similar conclusions, however, this research produces deeper results regarding the income inequality between provinces because it uses the extended Theil's index.

Griffin et al. (1994) compared the income in rural areas among all provinces, and the income in urban areas among ten provinces in 1988. But, they were unable to justify numerically the inequalities between the provinces in either rural or urban areas. Through their analysis on sampling, however, they concluded that income inequality between provinces was large, and that the income inequality between provinces in rural areas was larger than that in urban areas. The results in this research are basically consistent with theirs. The income inequalities between provinces in rural and in urban areas are 0.0243 in row (32) and column (1) and 0.0163 in row (32) and column (2) of Table 4.3, respectively. The former is one and a half times higher than the latter. The overall income inequality between provinces is 0.0208 in row (32) and column (3) of Table 4.3, which contributes to 24% of the overall income inequality in China.

4.5 Conclusion

Section 4, which decomposed the overall income inequality into four components: the income inequality between areas, between provinces, between social classes and within social classes and ignored the income inequality within social classes, showed the overall income inequality in China to be at a low level. Among the three de-

composed between-group income inequalities, the income inequality between social classes contributes the most, 43%, to the overall income inequality; the income inequality between rural and urban areas contributes the second greatest, 33%; the income inequality between provinces contributes the least, 24%. The results proved the argument that income inequality between rural and urban areas was large.

Other studies argued that there was a big income difference between the eastern part and the middle and western part, a small income difference between the middle and the western parts; and that there was a big income difference between the provinces within the eastern part and a small income difference between the provinces within the middle and the western part. The results in section 3 showed a similar situation. The other research did not shed any light on the income inequality between provinces. Griffin et al.'s (1994) work did not reveal any explicit result, but they argued that the inequality between provinces was large, and that the inequality between provinces in rural areas was larger than in urban areas. The results in this chapter proved their conjecture by showing that the inequality between provinces in rural areas was 0.024, and in urban areas is 0.016. Their average is 0.021, which contributes to 24% of the overall income inequality in China.

The biggest difference between this research and the others was that this research concluded that in China, like other developing countries in Asia, the income inequalities in rural and in urban areas in fact were very close. In particular, the income inequality between social classes in rural areas was lower than in urban areas, while the income inequality between provinces in rural areas was higher than in urban areas. Griffin et al. (1994) and Zhu (1990) argued that the income inequality in rural areas was in general greater than in urban areas. I found that this was true only in six of the ten developed provinces in the eastern part, and in one of the nine less-developed provinces in the middle part, whereas the income inequalities in the rural areas were lower than in the urban areas in the other 23 provinces.

The other research was unable to decompose the overall inequality in provinces into the inequality between social classes and the inequality between rural and urban areas. The study in this chapter achieved the decomposition of overall inequality. In particular, this study found that the inequality between social classes was higher than the inequality between rural and urban areas in all developed provinces, in six of the nine less developed provinces, and in four of the eleven least developed provinces.

Griffin et al. (1994) concluded that there was no relationship between the economic development and the income inequality in either rural or urban areas in provinces.

This chapter showed a similar situation. In particular, this research revealed that the overall inequality and the inequality between rural and urban areas was negatively related to the level of economic development in the provinces. Proved correct was the conjecture of Griffin et al. (1994), that the difference in the overall income inequality among provinces was approached mainly by the difference in the income inequality between rural and urban areas among provinces.

4.6 A final remark

Apart from the conclusion, it is also necessary to discuss the validity of the previous assumption in Chapter 3 that the within-class income inequalities were minor and could be ignored, as all the results in this chapter rely on the assumption. Comparing the results in this chapter with Zhang (1997)'s results, it can be concluded that the assumption in Chapter 3 was reasonable. Zhang found that the income inequality between rural and urban areas contributed nearly 33% of the overall income inequality in China in the year 1995 by the mean logarithmic deviation. The results in this chapter also reveal a 33% contribution to the overall inequality. Moreover, Zhang discussed that the income inequality within rural and urban areas contributed the rest (67%) of the overall income inequality, while the results in this chapter further reveal that the rest (67%) within-area inequality consists of the 43% inequality between social classes and the 24% of the inequality between provinces. Zhang also calculated that the income inequality between occupations of households contributed 37% of the overall inequality, which was less than my result that the income inequality between social classes contributes 43% of the overall inequality. The reason may be that he used the household as the unit while I use the individual as the unit; his results therefore ignored income inequality within the household.

Chapter 5

Resource Allocation and Values

5.1 Introduction

An economy is defined by three elementary factors: Preferences, initial endowments and technologies. Given these factors, a central issue is how to optimize the economy. However, because of the existence of various activities, commodities, and resources, this question is too complex to solve without the assistance of some special techniques. Linear programming is one method to search for the optimum solutions to a variety of economic problems.

Linear programming was first used by George B. Dantzig. Early works on the application of this technique on economic analysis are by von Neumann and Koopmans et al. (1951). Dorfman, Samuelson and Solow (1958) perhaps best illustrated its economic implications. A broad application of linear programming on macroeconomic issues has been done recently by ten Raa (1995).

This research applies the linear programming method to solve a general equilibrium model. Chapter 5 has two parts. First, it gives a brief review of the linear programming method. Since linear programming is used extensively in economics, formal and complete explanations abound in the literatures: D. Gale (1960), G. Dantzig (1963), S. Gass (1975), and A. Schrijver (1986). This chapter also focuses on an application of linear programming by analysing the allocation and value of scarce resources in an example.

Section 5.2 introduces the basic knowledge of linear programming. This section first introduces the standard formats of primal and dual programs. Consequently, the relevant constraints and solutions are discussed. Finally, this section presents the

important theorems of linear programming: the duality theorem. Section 5.3 uses an example to illustrate the program of resource allocation. The section discusses the problem of resource allocation with respect to the activities of an economy. The problem can be considered through its dual program as well. If resources are priced by their marginal product, and the economy uses these prices, then resources will be exhausted by the economy. Finding the exact prices of resources is therefore identical to selecting the economic activities that uses resources. The dual program offers a solution for the determination of prices. Section 5.4 uses the example to discuss the pricing of resources.

5.2 A brief review of linear programming

5.2.1 Primal and dual programs

Linear programming is a very special form of mathematical programming. It deals with the case in which the relationships between variables are linear. More specifically, a linear programming problem consists of an objective function and certain constraints. The objective function is linear, and the constraints form a system of linear inequalities. Through linear programming, one either maximizes or minimizes the objective function under the constraints. In the analysis of economic activity, a maximizing problem can be designed in which, given the resource endowments, the available technologies and individual preferences, a solution can be found as to how this economy allocates the resources in order to maximize its final output. A minimizing problem is stated as that given the non-positive profit restrictions on how an economy prices its resources in order to minimize the values of its total input. In general, the former is referred to as the primal program, while the later is the dual program. They are actually two ways of solving a linear program. The standard forms of the primal and dual programs are as follows:

Primal program

The standard matrix representation of a primal program is written as follows

$$\max ax \text{ subject to } Cx \leq b \tag{5.1}$$

where a is a row vector of objective function coefficients, x is a column vector of

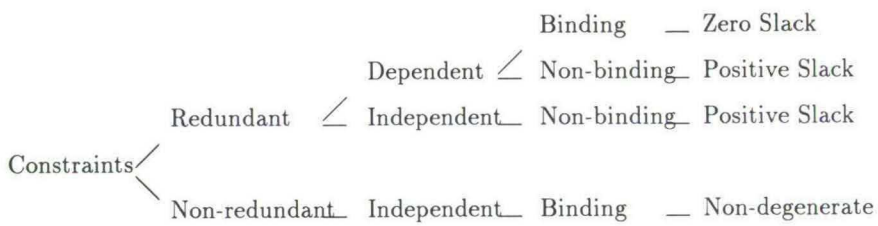
Slackness *A slack, σ_k, is a nonnegative difference between constraint, $C_k x$, and its bound, b_k, such that $C_k x + \sigma_k = b_k$.*

Binding and Non-binding *The constraint, C_k, with $\sigma_k = 0$, is binding; with $\sigma_k > 0$, it is non-binding.*

Both binding and non-binding constraints can be dependent or independent. The binding and dependent constraints are redundant, but the binding and independent constraints are non-redundant. The non-binding constraints, of course, are redundant.

Non-degeneration *A linear program, ax, s.t. $C^0 x \leq b$, is called a non-degenerate program if C^0 is the set of the binding and independent constraints.*

We summarize the constraints according to their definitions in the diagram below:



Relationships among the constraints are clear here. The nonredundant constraint is independent, binding, and therefore nondegenerate. Yet, the independent constraint may be nonbinding, and therefore redundant, and is rewarded a positive slack. Furthermore, the constraint does not have to be binding in order to be independent. It may be dependent, and therefore redundant (in which case it has a zero slack). Although it may be independent or dependent, the nonbinding constraint is certainly redundant, and is associated with a positive slack.

5.2.3 Solutions

Examining the properties of a solution to the linear program, will help us to predict and understand the possible results of later models. This section reviews some basic definitions of solutions.

Feasible solution *Any solution vector x satisfying the constraints, $Cx - b \leq 0$, is a feasible solution vector.*

Optimal solution *A feasible solution vector, x^*, which maximizes the objective function, is an optimal solution vector.*

variables, C is a matrix of constraint coefficients, one row for each constraint, and b is a column vector of constraint bounds.

The primal program can be transformed into its dual program according to the following rules:

1. The maximization becomes the minimization.

2. Each variable in the primal program requires a corresponding constraint in the dual program, while the coefficients of the variable become the coefficients of the relevant constraint in the dual program.

3. Each constraint in the primal program corresponds to a variable of the dual program, while the coefficients of the constraint are as the coefficients of the relevant variable in the dual program.

4. The coefficients of the objective function in the primal program are the constraint bounds of the dual program, while the constraint bounds of the primal program become the coefficients of the objective function in the dual program.

5. The inequalities in the primal program become equalities in the dual program, in addition to the non-negativity constraints.

Hence, the dual program is as follows:

Dual program

$$\min \lambda b \tag{5.2}$$

$$\text{Subject to } \lambda C = a \tag{5.3}$$

$$\lambda \geq 0, \tag{5.4}$$

where λ is a row vector of variables in the dual program.

5.2.2 Constraints

Since the system of constraints is often complex in a linear program, one needs to clarify the properties of and the relationships between the constraints.

Redundancy *The row C_k of matrix C is called a redundant constraint if the elimination of it will not affect the optimal value of the objective function, ax.*

Independence *The rows of matrix C are linearly independent if and only if $\mu C = 0$ implies that row vector $\mu = 0$.* (ten Raa, 1995, pp 56).

5.2.4 Opportunity costs

The discussion on employment of resources can be extended further. What special meanings are there behind the employment of resources? To answer that question, we shall first consider the case of full employment. If some resource has been fully employed, any added unit of that resource is able to increase the output by a corresponding part. In a perfectly competitive economy, the increase in the value of output is equal to the marginal cost of production of the commodity with the same resources. The marginal cost represents the opportunity cost (or shadow price), which is the price of the resource. If part of a resource is still unemployed, any added unit of the resource is also not employed, and therefore cannot increase output. In that case, the opportunity cost faced by firms is zero. In other words, the resource has a zero shadow price. In a competitive economy, the opportunity cost of the production of a commodity is equal to its market price.

Differences between unemployment and full employment are consequently reflected in the differences between the shadow prices of resources. The unemployed or partly employed resources have zero shadow prices, while the fully employed resources have positive shadow prices. Therefore, searching for the activities of an economy may be replaced by searching for the shadow prices of resources in the economy. It is naturally another aspect of the optimal allocation of resources, either maximizing total final output by fully employing the scarce resources or using the resources at their minimum prices. The two aspects are, in fact, equivalent. If a program has maximal output, then it must also have minimal costs, and vice versa.

However, there is an exception for the case in which the binding constraints are dependent, since the binding constraints are not necessarily independent. When they are dependent, some binding constraints are redundant. After the elimination of the redundant constraints, the remaining constraints are independent and binding, or non-degenerate.

5.2.5 Duality theorems

The optimality of resource allocation in values is similar to the primal program. The main theorems of duality presented in this section ensure the same principles between uses and values of resources.

The link between the allocations and the least costs of resources is identical. It is straightforward to see that if the activities with respect to the employment of

resources are optimal, the resources are paid for according to their marginal productivity. Meanwhile, if resources are priced by their opportunity costs or marginal costs, the activities with respect to the employment of the resources exhaust the value of the resources. More specifically, without consideration of the exception, if some resources are fully employed in the optimal allocation, these resources must get positive shadow prices. Otherwise, the resources partly employed or entirely unemployed will have zero shadow prices.

Duality theorem A (The duality theorem)

In optimality, the objective values of both primal and dual programs are the same; that is, if x^* and λ^* are the optimal solutions for the programs, respectively, then $ax^* = \lambda^* b$.

Duality theorem B (Complementary slackness theorem)

The optimal solutions of both primal and dual programs must satisfy, for any constraint, one of the following three conditions: (1) $C_i x^* < b_i$ and $\lambda_i = 0$ or (2) $C_i x^* = b_i$ and $\lambda_i > 0$ or (3) $\lambda_i = 0$ and $C_i x^* = b_i$.

The proofs of both theorems can be found in, e.g. Dantzig (1963, pp 136), or ten Raa (1995, pp 59-62).

5.3 Resource allocation: an illustration

This illustration features an economy in which there are three sectors and two types of commodities. The economy must produce one unit of commodity A per one unit of commodity B. Sectors 1 and 3 produce commodity A, and sector 2 produces commodity B, by different technologies that require the input of only two production factors: labor and capital. The labor endowment is six units. The capital endowments are 40 units for capital I and ten units for capital II. In sector 1, each unit of activity contributes two units of final output of commodity A at the cost of one unit of labor and ten units of capital I. In sector 2, each unit of activity contributes one unit of final output of commodity B at the cost of two units of labor and four units of capital II. In sector 3, each unit of activity contributes two units of final output of commodity A at the cost of 0.8 unit of labor and ten units of capital I.

Intuitively, the sectors are assumed to be nonnegative, they may be active or inactive, but cannot take negative activity. Let s_i, D_j and D denote the active level in sector i, the final output of commodity j and aggregate final output, respectively.

With the conditions stated above, if the economy wants to maximize its total final output, the example can be written as the following primal program:

Maximize D

Commodity A's Constraint $2s_1 + 2s_3 \geq D_A$

Commodity B's Constraint $s_2 \geq D_B$

Consumer's preference $D_A = D_B$

Labor Constraint $s_1 + 2s_2 + 0.8s_3 \leq 6$

Capital I's Constraint $10s_1 + 10s_3 \leq 40$

Capital II's Constraint $4s_2 \leq 10$

Nonnegative Constraint $s_1, s_2, s_3 \geq 0$

5.4 Values of resources: the dual of the example

In the standard format, the relevant items are as follows:

$$a = \begin{bmatrix} 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\mathrm{x} = \begin{bmatrix} \mathrm{s}_1 \\ \mathrm{s}_2 \\ \mathrm{s}_3 \\ \mathrm{D} \end{bmatrix}$$

$$C = \begin{bmatrix} -2 & 0 & -2 & 0.5 \\ 0 & -1 & 0 & 0.5 \\ 1 & 2 & 0.8 & 0 \\ 10 & 0 & 10 & 0 \\ 0 & 4 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

$$b = \begin{bmatrix} 0 \\ 0 \\ 6 \\ 40 \\ 10 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\lambda = \begin{bmatrix} P_1 & P_2 & \omega & \gamma_1 & \gamma_2 & \sigma_1 & \sigma_2 & \sigma_3 \end{bmatrix}$$

,

Here, P_1, P_2, ω, and γ_i are the prices of commodity A, B, labor, and capital, respectively. σ_i is the slack variable. According to the Duality theorems, the primal program can be transformed into its dual program:

$$\text{Minimize } 6\omega + 40\gamma_1 + 10\gamma_2$$

Subject to

$$\omega + 10\gamma_1 \geq 2P_1$$

$$2\omega + 4\gamma_2 \geq P_2$$

$$0.8\omega + 10\gamma_1 \geq 2P_1$$

$$0.5P_1 + 0.5P_2 = 1$$

The above problem can be solved by the routine of the simplex method.

Chapter 6

The Computable General Equilibrium Model

6.1 Introduction

Chapter 4 investigated the current situation of income distribution in China. Apparently, functional income distribution in China is determined by both market and non-market forces. Wages do not show a significant relationship with labor productivity, and capital market is under construction. Income distributions are therefore the mixed result of market and non-market forces.

Under competitive markets, income distribution is formed internally by the economy rather than by any public institution. From an economic point of view, personal income should be determined by working abilities and property advantages. Because of the failure of competition in some markets[1], monopoly advantages often distort the economy. This research is confined to a situation of perfect competition and therefore eliminates the impact of monopoly. Windfall profits always affect personal income, but the effect usually is unforeseeable and can never be treated as predominant. It is also ignored in this research. In brief, this chapter aims to describe the endogenous determination of primary income in perfectly competitive markets. Precisely speaking, it seeks to determine income from labor skills and properties. The essence of the economic determination of personal income is to consider income generation and distribution in an economic system in which production, distribution and consumption flow interactively. Production generates income, income distribution determines

[1]See Stiglitz (1988).

consumption, which in turn creates demands for production. As a static model, this model is confined to describing the first part of the circle: income generation in the production process.

Theoretically, it is possible to construct models that are able to describe the functional income distribution in competitive markets. Given scarce resources, constant or decreasing returns to scale technologies, and the preferences of the society, the productivity of labor and capital can be determined. In competitive markets, they are identical to the efficient wage rates and rental rates, respectively. Technically, it is also possible to solve such models if they are not too complex and in reasonable scale.

This chapter constructs a general equilibrium model of a competitive Chinese economy to capture the internal forces determining income. In the model, production takes place according to Leontief's technologies, the preferences are determined by the observed composition of domestic final demands, and the endowments consist of labor and capital. Primary income consists of labor and capital income which, according to neo-classical theory, are paid their marginal productivity.

This model is non-linear. It consists of a linear program core and a non-linear equations system.[2] The primal linear program shows production relationships, while its dual reveals the aspect of cost relationships. The non-linear equations are for the balance of payments. Precisely speaking, the non-linear equations' function is to control the equilibrium in order that the gross value of net exports of each province in the economy must match their observed value. By means of linear programming and Newton methods for non-linear equations, we can simultaneously solve endogenous variables in the model when the economy reaches its optimum.[3] As a result, the model is able to describe both macroeconomic and microeconomic issues in the competitive economy such as economic structure, employment, efficiency, consumption levels, trade patterns and comparative advantage, productivity, and functional income distribution.

The empirics in this research consider the provincial economy to be independent

[2]This kind of model is identified as an intermediate step between classical linear programming and the modern non-linear computable general equilibrium models by Dervis et al. (1982). Its non-linear part captures the feedback effects to the linear program.

[3]There are two problems that we need to be aware of when we use a large-scale model like the one featured in this research: first, the linear programming may have difficulty being executed; second, the non-linear equations may not converge either quickly or directly. In the empirical part of this research, I use a so-called sparse matrix method to execute the large scale linear programming, and start with two well-estimated initials to solve the non-linear equations by the Newton method.

in China, and the national economy to be an integration of the provincial economies. Under the integrated markets, provinces compete with each other, trade between provinces is perfectly free (unhindered and free of charge), and international trade with countries outside China is fixed as an external resource. In general equilibrium, Chinese domestic final output reaches the maximum by optimally allocating resources. As a result, prices of commodities and factors are endogenously determined.

Section 6.2 discusses economic specifications to the model, section 6.3 presents the model, and section 6.4 paves the way for the empirics.

6.2 Economic specifications

6.2.1 Neo-classical approach

It is not really a new idea to consider personal income from an economic point of view. Although most of the classical and neo-classical economists were concerned primarily with personal income as the result of windfall and other sources, neo-classical theory has indeed drawn some attention to the economic determination that personal income depends on factor endowments and their prices, which are set in turn, by the marginal productivity of factors in the competitive markets.

Classical economists such as Ricardo and Marx have been concerned with the role of land and labor in the determination of personal income. Ricardo considers only two factors of production: land and labor. They enter the production process directly and yield rewards as rents and wages. Capital is treated only as the indirect production factor and the subsistence for the support of labor during the production process. Rents are received on land, and labor receives wages, but the returns on capital, or the amount and the rate of profit depend on the difference between the marginal productivity of labor in agriculture and the wage rate.

On the basis of classical Ricardian theory, neo-classical economists have made considerable progress by the introduction of the marginal productivity theory. Neo-classical economics would discard the special position of the rent of land and would mention the role of all specific factors in pricing the factor endowments. As land and labor, capital earned interest by its marginal productivity. In competitive markets, given a constant or decreasing returns-to-scale technology, competition may yield an equilibrium in which all the production factors are paid by their marginal products, and the price ratios between factors correspond to the slopes of the isoquant at the

point located by the factor endowments.

Neo-classical theory has become one of the most attractive theories in modern economics, not only because it provides great insight into the competitive economy and the determination of income, but also because it permits modelling the competitive economy and numerically solving the model. There have been some efforts towards modelling a competitive economy and, especially, accounting for factor prices. Explorations in this direction, however, have not yet been broadly recognized possibly because almost all the existing models modelling attempts have not reached a sufficient degree in their description of a competitive economy. In general, the more detail given to modelling, the more complex the work becomes, and the more techniques and information are required. Such models become, then, difficult to apply. This problem motivated economists to search for more efficient and advanced methods to modelling. Recently, ten Raa (1995) proposed a series of theoretical models and some empirical works on this direction. His work combines the applications of the system of national accounts, input-output techniques, and linear programming. In his theoretical structure, factor prices are determined endogenously.

6.2.2 Labor value

The value of labor is measured by the wage (that is, the product of the wage rate and the hours worked). In general, the hours worked are supposed to be constant – therefore only the wage rate matters. According to neo-classical theory, (under perfect competition) if technology exhibits constant or decreasing returns to scale, a firm will hire more labor until the wage rates equal the marginal products of labor.

When there are various types of labor, the wages are differentiated by the different wage rates. Since the abilities of labor may differ, the ability of each type of labor is reflected by the marginal productivity of each type of labor. It turns out that the differences between wage rates are determined by the differences between labor ability. The ability of labor may depend on innate factors and postnatal acquirements. They are reflected in the differences among such things, as social status and position. Intuitively, a person with higher ability is more productive and therefore needs to be paid more. According to Mincer (1985), the earning differences among occupations are systematic; the higher the occupational rank, the higher the level of earnings.

This model distinguishes labor into four types according to occupations or skills. They are unskilled, skilled, manager, and technician increasing in rank. The model

allows for the substitution from higher to lower rank labor. There is a hierarchy for such substitutions that has been proposed by Mohnen, ten Raa and Bourque (1995). For example, assume that an economy consists of one sector and two types of labor, namely unskilled and skilled.

Let L, N and X represent production input demands for labor per unit of production, labor resources, and production activity, respectively. The labor inputs are as follows:

$$L_{unskilled}X \leq N_{unskilled} \tag{6.1}$$

$$L_{skilled}X \leq N_{skilled} \tag{6.2}$$

Assume that skilled labor is employed partly, and denote the unemployment of skilled labor as $N^u_{skilled}$, then

$$N^u_{skilled} = N_{skilled} - L_{skilled}X \tag{6.3}$$

As skilled labor is able to substitute for unskilled labor, the unemployed among the skilled labor will go to the pool of unskilled labors. The situation now becomes:

$$L_{unskilled}X \leq N_{unskilled} + N^u_{skilled} \tag{6.4}$$

$$L_{skilled}X \leq N_{skilled} \tag{6.5}$$

substituting (6.3) into (6.4), then

$$(L_{unskilled} + L_{skilled})X \leq N_{unskilled} + N_{skilled} \tag{6.6}$$

$$L_{skilled}X \leq N_{skilled} \tag{6.7}$$

Theoretically, in competitive markets where agents are utility-driven, labor is a mobile factor. This research assumes that labor is mobile among sectors, motivated to seek more income. However, the model maintains that if labor has to migrate, there is a loss of hometown utility. Labor's decision to migrate therefore depends on the net income after the more-income utility gain minus the hometown utility loss. As the model excludes hometown utility, it simply assumes that the income utility

gain will not exceed the hometown utility loss by migration as long as labor has any income. Because of the substitutive effect in the model, skilled labor, if losing work, will prefer occupying lower positions to migrating. Unskilled labor have no room for substitution, and therefore have to migrate if they become redundant in local markets. On the basis of this reasoning, the model assumes that all types of labor are mobile between sectors, unskilled labor is perfect mobile within the nation, and skilled labor, managers and technicians are mobile only within each province. Because the wage rate is identical to the ability of each type of labor, the wage rate of unskilled labor is unique across all sectors and provinces, and the wage rates of skilled labor, managers and technicians are different in each province.

6.2.3 Capital value

Capital's situation is similar to that of labor. The value of capital return is equal to the product of capital endowments and the rental rate. When capital endowments are given, only the rental rates matter. In general equilibrium, the marginal productivity of capital determines the rent. Moreover, capital can be further distinguished into two formations, namely fixed capital and circulating capital, according to its performance. Fixed capital depreciates gradually and is fixed in each production process. On the other hand, circulating capital depreciates entirely and is mobile among sectors – it constitutes the contents of intermediate inputs of production. Because fixed capital is an imperfect substitute (in other words, there are various kinds of fixed capital in each sector), each kind of the fixed capital specifies a rental rate corresponding to the different marginal productivity of the fixed capital. The fixed capital forms the sector capital stock. The value of capital stock is the sum of the products of various sector capital endowments and their rental rates.

The differences between the rental rates of fixed capital are related to the technology characteristics of the fixed capital. For simplicity, this research assumes that technologies are set up with respect to sectors. The special technology in each sector brings the corresponding productivity of the fixed capital employed in this sector. Thus, the fixed capital is sector specific and each sector yields a unique rental rate. Intuitively, the rental rate depends on the scarcity of capital and the technology associated with the capital. However, the ownership of capital does not affect the marginal productivity of capital, because ownership has no impact on the production by firms and sectors.

This model specifies the fixed capital in each sector. There are as many types of fixed capital as there are sectors. Each sector has its own constraint of fixed capital and, therefore, features a corresponding number of rental rates and sectors. If a capital holder owns various types of sector capital stocks, his capital income is the sum of the incomes of each type of sector capital stocks, which are the product of the endowments of sector capital stocks and their rental rates. Therefore, the capital endowments, the rental rate, and the composition of capital stock, determine the capital income of capital holders.

6.2.4 Commodity and service input

Besides the factor input discussed above, production also needs commodities and services as inputs. Sectors may use their own products and the products from other sectors as intermediate inputs. The composition of input in a particular sector depends on the technology that the sector uses. Sectors therefore interact in the economy. Just as in standard input-output analysis and linear programming, the commodity and service inputs exhibit constant returns to scale, and their proportions to output are fixed in the model.

6.2.5 The final product

The final product, or net output, is the surplus of gross product minus intermediate uses. In an open economy, the final products include the domestic final uses and net exports. The goal of an economy may be to maximize overall domestic final products or uses. Without considering leisure in this static model, the domestic final-use level is a better indicator of the welfare of an economy. Its use consists of domestic consumption and investment.

The composition of the domestic final product is important because that it may reveal household preferences. This research uses the observed composition of all the final products (including public consumption) as given preferences of households in economy.

6.2.6 The competitive provinces

Chapter 4 mentioned that China constitutionally consists of 30 provinces, each of which could be regarded as a small economy. This research is intended to simulate

an integrated Chinese national economy in which the provinces compete with each other. However, owing to the data problem (which I will explain in detailed later in this chapter), the modelling in this research has to consider only 27 of the 30 provinces, while assuming that the remaining three provinces, Neimeng, Hainan and Tibet, will not participate the competition. The exclusion of the three provinces will not affect the results of the competition, because Neimeng is a middle-sized province, and Hainan and Tibet are the smallest provinces in China; their shares in national GNP in 1991 account for only 0.58%.[4]

6.2.7 Open economy

In an open economy, the net output of any specific commodity and service could be either positive or negative, depending on the net exports. The theory of comparative advantage reveals that a country gains from international trade if it produces its advantageous products and imports disadvantageous products from other countries.

Trade between Chinese provinces is basically free. The provincial input-output tables reveal that the trade data on all sector products (except for the sector of administration) are non-zero. For each type of the tradable products, there is a unique price across the same sector in all provinces, while for the non-tradable product, both export and import are zero. The prices of tradable and non-tradable products are endogenously determined by the prices of production factors in the model.

6.2.8 The competitive equilibrium

Under perfect competition, an economy is able to reach a state of equilibrium in which households' utilities and the sectors' profits are maximized subject to the budget constraints, and the total excess demand is zero. Such an equilibrium is supported by a price system and a corresponding active allocation, which is called the Walrasian equilibrium.

This model simulates the competitive Chinese economy in the following way. Given initial endowments of production factors, constant or decreasing returns-to-scale technology and fixed preferences, maximizing the overall domestic final uses determines the efficient outcome in which there are only active sectors remaining. By the second welfare theorem, the efficient prices and allocation are the Walrasian equilibri-

[4]According to the 1994 China Statistical Yearbook.

um. As a result, the solution exposes the market economy as follows: wage and rental rates, commodity prices, sector activities, domestic and provincial final uses, and net exports in provinces.

6.3 The general equilibrium model

6.3.1 Primal program

The model aims to maximize China's domestic final uses. The objective function in the model is only a scalar, D, which represents the overall value of national final uses and in fact is the sum of the values of final uses in all sectors in all provinces:

$$\text{Max D} \tag{6.8}$$

The primal program includes commodity, labor, capital and nonnegativity constraints. The commodity constraints include 29 tradable commodity constraints for 27 of all 30 provinces, and 27 non-tradable commodity constraints, one for each province. The commodity balance requires that final supplies will not be less than final demands. Denote the variables which are exogenous to the linear program as follows:

A_t^i is a square matrix of intermediate input coefficients regarding tradable commodities, 30 by 30, of province i (as this model is involved with 30 sectors). In the last, or 30th, row in the matrix, all elements are zero, which means that the non-tradable commodity is not included.

f_t^i is a column vector of the proportions of province i's final uses regarding tradable commodities, by 30. Its last element is zero.

E^i is a column vector of province i's net exports to outside China, by 30. The last element of the column is also zero.

d^i is a scalar of province i's overall final uses in overall domestic final uses.

and the endogenous variables are as follows:

X^i is a column vector of province i's outputs, by 30.

D is a scalar of overall domestic final uses.

Balance of tradable commodities:[5]

$$\sum_{i=1}^{27}(I - A_t^i)X^i \geq \sum_{i=1}^{27} f_t^i d^i D + \sum_{i=1}^{27} E^i \tag{6.9}$$

[5]In all the following equations, the superscripts indicate the number of the province.

Equation 6.9 shows the balance of tradable commodities. On the left-hand side, the supplies of each province, i, are obtained by extracting intermediate input, $A_t^i X^i$, from total output, X^i; by each type of tradable commodities; its provincial supplies are added to national supply in a column vector by tradable commodities. The first term on the right-hand side is domestic final uses that are obtained by accumulating the provinces' final uses. There, overall province i's final use, D^i, is regarded as a proportion, $d^i D$, of overall domestic final use, where d^i represents the proportion of overall province i's final use to overall domestic final use. province i's overall final use is further specified to each type of tradable commodity according to the proportions, f_t^i, of the final use for each type of tradable commodities to overall final use in province i. f_t^i is an exogenous column vector consisting of 29 proportions, one for each type of tradable commodity. The second term on the right-hand side is the exogenous net exports to outside China, which is accumulated from each provincial net exports to outside China, E^i. This term is also specified for each type of tradable commodity, and is therefore a column vector. Because there is a unique market for each type of tradable commodity over the country, there are 29 balances in total, one for each type of tradable commodity.

The non-tradable commodities exist in each province separately. There are 27 provincial markets of non-tradable commodities, and one balance for each market. Denote that

A^i is a square matrix of intermediate input coefficients regarding the non-tradable commodity, 30 by 30, of province i. In the matrix, except for the elements in the last row, all other elements are zero, which means that tradable commodities are not included.

f^i is a column vector of the proportions of province i's final uses regarding the non-tradable commodity, by 30. The first 29 elements of the column must be zero.

Balances of non-tradable commodities in provinces:

$$(I - A^i)X^i \geq f^i d^i D, i = 1, ..., 27. \tag{6.10}$$

The model has 82 labor constraints. Among them, each province has three labor constraints: namely technicians, managers, and skilled labor. The unskilled labor constraint is national, since unskilled labor is assumed to be mobile over the country. The hierarchy of substitution of high for low rank is embodied in the labor constraints. Denote that

L^i is the matrix of the input coefficients of three types of skilled and highly-skilled labor in province i, 3 by 30,

N^i is a column vector of initial endowments of three types of skilled and highly-skilled labor, by 3.

Balances of the three types of labor resources in provincial markets:

$$L^i X^i \leq N^i, i = 1, ..., 27. \tag{6.11}$$

where

$$\mathrm{X^i} = \begin{bmatrix} \mathrm{X^i_1} \\ \bullet \\ \bullet \\ \bullet \\ \mathrm{X^i_{30}} \end{bmatrix}$$

$$\mathrm{L^i} = \begin{bmatrix} (\mathrm{L^i_{1,1}}) & ..... & (L^i_{1,30}) \\ (\mathrm{L^i_{1,1}} + \mathrm{L^i_{2,1}}) & ..... & (L^i_{1,30} + L^i_{2,30}) \\ (\mathrm{L^i_{1,1}} + \mathrm{L^i_{2,1}} + \mathrm{L^i_{3,1}}) & ..... & (L^i_{1,30} + L^i_{2,30} + L^i_{3,30}) \end{bmatrix}$$

and

$$\mathrm{N^i} = \begin{bmatrix} \mathrm{N^i_1} \\ \mathrm{N^i_1} + \mathrm{N^i_2} \\ \mathrm{N^i_1} + \mathrm{N^i_2} + \mathrm{N^i_3} \end{bmatrix}$$

Denote that

L^i_u is a row vector of the input coefficients of both unskilled labor and the skilled and highly-skilled labor in province i, by 30,

N^i_u is a scalar of endowments of both unskilled labor and the skilled and highly-skilled labor in province i.

The balance of unskilled labor resources in the national market:

$$\sum_{i=1}^{27} L^i_u X^i \leq \sum_{i=1}^{27} N^i_u$$

where

$$\mathrm{L^i_u} = \left[\ (\mathrm{L^i_{1,1}} + \mathrm{L^i_{2,1}} + \mathrm{L^i_{3,1}} + \mathrm{L^i_{4,1}}) \ ..... \ (L^i_{1,30} + L^i_{2,30} + L^i_{3,30} + L^i_{4,30}) \ \right]$$

and

$$N_u^i = \left[N_1^i + N_2^i + N_3^i + N_4^i \right]$$

The model has 810 constraints of capital in total, 30 constraints for each province, as capital is completely immobile. Denote that

$\hat{K}^i$ is diagonal matrix of input coefficients of fixed capital in province i, 30 by 30,

M^i is a column vector of endowments of fixed capital in province i, by 30.

Balances of the capital resources in the provincial markets:

$$\hat{K}^i X^i \leq M^i, i = 1, ..., 27. \tag{6.12}$$

Nonnegative activity:

$$X \geq 0$$

6.3.2 Dual program

The model has a dual program with the objective to minimize the overall cost of domestic resources. Denote the following endogenous variables:

P_t is a row vector of the shadow prices of tradable commodities, by 30. Its last element is zero.

ω_u is a scalar of the efficient wage of unskilled labor.

ω^i is a row vector of the wage premiums of three type of immobile labor (skilled, managers and technicians) over lower rank labor's wage in province i, by 3. In the vector, the first element is the technician's wage premium over the manager's wage, the second is the manager's wage premium over the skilled wage, and the third is the skilled wage premium over the unskilled wage.

γ^i is a row vector of the rental rates of fixed capital in province i, by 30.

P^i is a scalar of the price of the nontradable commodity in province i.

The objective function is the following:

$$\min \sum_{i=1}^{27} \gamma^i M^i + \sum_{i=1}^{27} \omega^i N^i + \omega_u \sum_{i=1}^{27} N_u^i - \sum_{i=1}^{27} P_t E^i \tag{6.13}$$

The dual program has 810 budget constraints, 30 constraints for each province:

$$P_t(I - A_t^i) + P^i(I - A^i) \leq \omega_u L_u^i + \omega^i L^i + \gamma^i \hat{K}^i, i = 1, ..., 27. \tag{6.14}$$

In addition, there are 27 constraints for normalizing relative prices:

$$P_t f_t^i + P^i f^i = 1, i = 1, ..., 27. \tag{6.15}$$

Practically, the primal program is constructed first, and then is transformed into the dual program through the standard format of the linear program, by which the primal program can be written as follows:

Max ax

Subject to

$$Cx \leq b$$

where
(1)

$$x = \begin{bmatrix} X^1 \\ \bullet \\ \bullet \\ \bullet \\ X^{27} \\ D \end{bmatrix}$$

(2)

$$a = \begin{bmatrix} 0 & . & . & . & 0 & 1 \end{bmatrix}$$

(3)

$$b = \begin{bmatrix} -\sum_{i=1}^{27} E^i \\ 0 \\ \sum_{i=1}^{27} N_u^i \\ N^1 \\ \bullet \\ \bullet \\ \bullet \\ N^{27} \\ M^1 \\ \bullet \\ \bullet \\ \bullet \\ M^{27} \\ 0 \end{bmatrix}$$

(4)

$$C = \begin{bmatrix} (A_t^1 - I) & \ldots & \ldots\ldots & (A_t^{27} - I) & \sum_{i=1}^{27} d^i f_t^i \\ (A^1 - I) & 0 & \ldots\ldots & 0 & d^1 f^1 \\ \ldots & \ldots & \ldots\ldots & \ldots & \ldots \\ 0 & \ldots & \ldots\ldots & (A^{27} - I) & d^{27} f^{27} \\ L_u^1 & \ldots & \ldots\ldots & L_u^{27} & 0 \\ L^1 & 0 & \ldots\ldots & 0 & 0 \\ \ldots & \ldots & \ldots\ldots & \ldots & 0 \\ 0 & \ldots & \ldots\ldots & L^{27} & 0 \\ \hat{K}_1 & 0 & \ldots\ldots & 0 & 0 \\ \ldots & \ldots & \ldots\ldots & \ldots & 0 \\ 0 & \ldots & \ldots\ldots & \hat{K}_{27} & 0 \\ -I & \ldots & \ldots\ldots & -I & 0 \end{bmatrix}$$

By the dual theorem, the primal and the dual programs have equal solution values, $ax^* = \lambda^* b$, or $max\{ax|Cx \leq b\} = min\{\lambda b|\lambda \geq 0; \lambda C = a\}$. Then, the standard format of the dual program is

Min λ b

Subject to

$$\lambda C = a$$

$$\lambda \geq 0$$

where

(5)

$$\lambda = \left[\begin{array}{cccccccccccc} P_t & P^1 & \ldots & P^{27} & \omega_u & \omega^1 & \ldots & \omega^{27} & \gamma^1 & \ldots & \gamma^{27} & \sigma \end{array} \right]$$

σ is slack.

6.3.3 The nonlinear equation system

In the previous linear program model, interprovincial trade is implicit. The value of the net exports to the rest of China in a province represents the difference between final supply and demands. Denoting S_d^i as the overall value of net exports to the rest of China in province i, and S_o^i as the observed value of net exports to the rest of China in province i, the overall value of the net exports in each province can be expressed in the following equations:

$$S^i(d) = P_t[(I - A_t^i)X^i - f_t^i d^i D - E^i], i = 1, ..., 27. \tag{6.16}$$

In equilibrium, the overall value of net exports to the rest of China in a province should match a certain level, depending on the modelling purpose. For example, it may match actual surplus on the trade account, or may be set to zero when the value of exports equals the value of imports. In the model, the overall value of net exports for each province to the rest of China is required to equal actual surplus on the trade account:

$$S^i(d) = S_0^i, i = 1, ..., 27. \tag{6.17}$$

These equations have three types of variables, namely the prices P_t, the outputs X and the shares of provincial final use in overall domestic final use d. As prices and outputs are the solutions to linear programming and the shares of final use prior to the linear programming, the solutions to linear programming depend on the values of d. Therefore, the overall value of net exports to the rest of China is in fact the function of d. The solution, d^*, of this non-linear equation is obtained by interactively solving the linear program and applying the Newton method shown below.

Define $S^i(d) - S_0^i = 0$, by the Newton algorithm,

$$d^i_{n+1} = \frac{[S^i(d_n) - S^i_0]d^i_{n-1} - [S^i(d_{n-1}) - S^i_0]d^i_n}{S^i(d_n) - S^i(d_{n-1})}$$

if d^i low, $S^i(d) > 0$

if d^i high, $S^i(d) < 0$

This method here uses a two-value strategy to calculate the Newton step. The procedure to solve the full model takes following steps:

First, set up two sets of well-guessed initial values, d_0 and d_1, respectively, prior to linear programming.

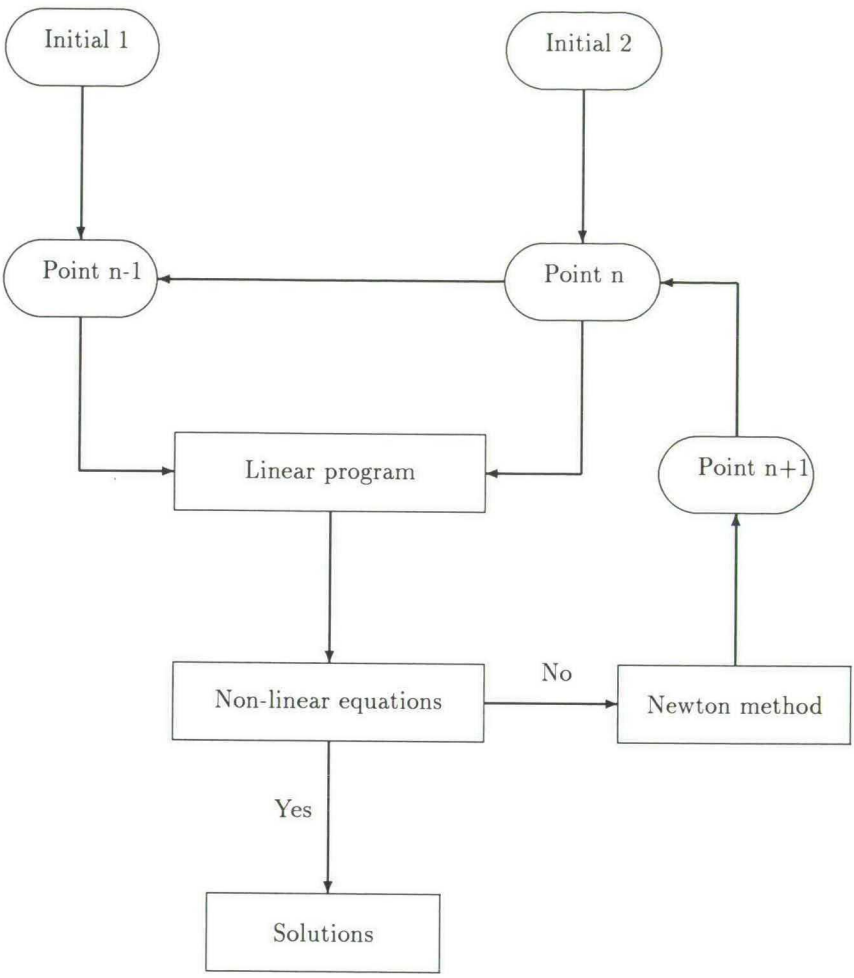
Second, with the two initial values, run the linear programming twice respectively towards reaching the optimality – where the optimal prices and outputs are solved.

Third, compute non-linear equations. If the non-linear equations, corresponding to any of the two optimal stages, are fulfilled, the model reaches the general equilibrium. Otherwise,

Fourth, use the two given sets of the values of d and the two corresponding overall values, $S(d_{n-1})$ and $S(d_n)$, of net exports, Newton's algorithm solves a new set of the shares of provincial final use in overall domestic final use, d, which should result in the closer approximation to the solution of the non-linear equations.

Fifth, with the new set of d that was solved with Newton's algorithm, run the linear programming once again; if current overall values of net exports to the rest of China match the observations, the non-linear equation system is solved – and subsequently the linear program is also solved with the final d. Otherwise, substitute the second d for the first d and the current d for the second d, and starti again from step four until the calculated overall values of net exports to the rest of China converge to the observed levels.

The solving procedure is presented graph 6.1, in which circles represent the shares of provincial final use in overall domestic final use, squares are computations. Arrows indicate the computing procedure. If non-linear equations are fulfilled, the "Yes" leads to the solutions of the model; otherwise, the "No" leads to the next round computation.



Graph 6.1 Computing Process

6.3.4 The Walrasian equilibrium

The present model is carried out toward an optimization, with its solution accompanied by the so-called shadow multipliers or shadow prices. It can be seen that the shadow prices associated with the optimal solution of this model are in fact the competitive equilibrium prices that support a **Walrasian equilibrium**, which is defined

as a price system and the corresponding allocation that ensure that the households and sectors behave optimally and the total excess demand is zero. Equations 6.20 - 6.23 trace profit maximizations in all sectors. Take any one of those equations in sector j in province i, it is

$$P_{tj} + P^i \leq P_t a^i_{tj} + P^i a^i \omega_u l^i_{uj} + \omega^i l^i_j + \gamma^i_j k^i_j$$

The left-hand side in the above equation represents the unit price, while the right-hand side represents the intermediate cost, labor and capital costs. The duality theorem B, or complementary slackness theorem in Chapter 5, ensures that production costs will exactly equal prices for all commodities that are actually produced, and that the commodities with costs higher than prices will not be produced.

6.4 The empirics

6.4.1 The data

Provincial input-output tables

This research considers 27 Chinese provinces in competition, whereas 30 administrative provinces exist formally in China. The remaining three provinces that are not included in the competition, due to data problems, are Hainan, Tibet and Neimeng. Among them, Hainan and Tibet did not produce their input-output tables, and Neimeng's input-output table was too particular in its sector classification, and hence was incompatible with the input-output tables of other provinces. For this reason, the three provinces have been discarded from the model. The other 27 provinces have produced their 1992 input-output tables in square-matrix form. Most of them have three versions, namely 6×6, 33×33 and 118×118 sectors or commodities. The model chooses to use the 33×33 version, for the sake of simplicity. The 33 sectors' table has been adjusted, to accommodate this research, into a 30 sectors' table,[6] where maintenance, repair and other industries, commerce and restaurants, freight and passenger transports are combined. The tables can provide a number of data sets such as intermediate input, value added, domestic final use, interprovincial and international trade, and gross output.

The provincial input-output tables are not perfectly consistent. Among the 27 provincial tables, 15 of them do not separate the information on interprovincial and

[6]See, appendix 6.A for the specification of the 33 sectors.

international trade. This problem has indeed caused a lot of inconvenience for the research. Because there is almost no reliable information that can be used to separate the net export to the rest of China and the net export to the rest of the world (in those 15 provinces), I have had to separate the data by the following estimations:

First, because twelve provinces have separate information on interprovincial and international trade, the export to and import from the rest of China in each of the 12 provinces are available. The sum of exports to the rest of China in those provinces is 829,781.57 million Yuan, the imports are 898,959.09 million Yuan, and the sum of the net export is therefore -69,177.52 million Yuan. Because the overall provincial net export is zero, it can be expected that the sum of the net exports to the rest of China in the 15 provinces that do not have separate information on interprovincial and international trade must be 69,177.52 million Yuan. It is, however, impossible to directly derive the export and import to the rest of China in these 15 provinces. They have to be estimated by assuming that the ratio of the overall exports (829,781.57 million Yuan) to gross output (3,766,102.38 million Yuan) in the 12 provinces, which is 0.22, is equivalent to the ratio of the overall import (58,595.71 million Yuan) to gross output (2,663,441.38 million Yuan) in the 15 provinces. Such an assumption makes it possible to estimate the overall import from the rest of China in the 15 provinces as 585,957.10 million Yuan (the overall export is 655,134.62 (585,957.10+69,177.52) million Yuan). The overall export is further distributed to each of the 30 sectors according to the shares of the net exports in each sector in the overall net export. Once exports to the rest of China in the 15 provinces are estimated on the sectoral level, imports from the rest of China are the sum of the exports and the net exports of the other 12 provinces, according to material balance.

While data on the export to and import from the rest of China in the 15 provinces are separated into 30 sectors, the data need to be further separated with respect to the 15 provinces. The mixed data on interprovincial and international trade in these 15 provinces are known. Therefore, we can calculate the shares of the mixed export to the rest of China and to the rest of the world in each province to the overall export in the 15 provinces. Assume that these shares are equivalent to the shares of the export to the rest of China in each of the 15 provinces. Then, in the overall export to rest of China in the 15 provinces, the overall export to the rest of China in the 15 provinces to each of the 15 provinces can be separated. The same procedure is applied to the imports from the rest of China.

The overall export to and the overall import from the rest of China in the 15

provinces need to be separated with respect to sectors and provinces. This is a complicated procedure. Here, the RAS method[7] is employed. There is a table (in which columns 1-27 and rows 1-30 show the data of exports) that is a mixture of the exports to the rest of China and the rest of the world, in the 15 provinces. Column 28, which is the sum of columns 1-27, shows the overall exports at the sectoral level; row 31, which is the sum of rows 1-30, indicates the overall exports at the provincial level. Columns 1-28 and rows 1-31 are the original data, while column 29 and row 32 are the data estimated above. The former are the overall exports to the rest of China at the sectoral level; the latter are the overall exports to the rest of China at the provincial level. The data in columns 1-27 and rows 1-30 need to be adjusted such that the sum of columns 1-27 equals column 29, and the sum of rows 1-30 equals row 32 by the RAS method. The same procedure is also applied to the import from the rest of China. Once the exports to and the imports from the rest of China are separated, the exports to and the imports from the rest of the world can be obtained by extracting the exports to and the imports from the rest of China from the total mixture of exports and imports.

After total exports and imports are divided into the exports to and the imports from the rest of China and from the rest of the world in the 15 provinces, I finally obtain a consistent database regarding all 27 provincial input-output tables. In the data base, there are 30 types of commodities, 29 of which are tradable (public administration is nontradable because the exports and imports of administrative service are zero in each of the provincial input-output tables). In the database, the overall net export to the rest of China for each commodity across provinces is zero. This database could, in fact, be considered as a sort of national input-output table for China. It has a difference, however, from the national input-output table in China that is produced separately by the state authority. The gaps between the national table and this aggregated 27 provincial input-output table may result from the excluded data on three provinces of Neimeng, Hainan and Tibet, and on state activities, which cannot be presented by the provincial data.

Capital usage and stocks

Besides the provincial input-output tables, the model requires data on capital usage and stocks at both sectoral and provincial levels. Because the input-output table

[7]For a detailed introduction to the RAS method, see Bacharach (1970).

includes information on capital returns rather than on capital usage and stocks, the data need to be collected from other sources.

The China Statistical Yearbook provides some information on capital stocks. The information, however, is insufficient for this research in three respects. First, the information is on state-owned firms rather than on total firms; second, the data are presented with respect to the national economy rather than the provincial economies; and third, the data are presented with respect to only six sectors rather than the thirty sectors that are required by the model. Detailed information on capital stocks in industrial sectors, however, has recently become available, which was collected by the department of industry in the State Statistical Bureau (SSB) through an industrial census. The SSB has made available to me the unpublished data on capital stocks in the year 1992 for 40 industrial sectors by province. I adjust these data to suit this research by aggregating them into 23 industrial sectors according to the sector classifications in the input-output table. The data have two parts: the capital stocks and the capital for production, but they do not include capital usage directly. According to statistics in China, the capital for production is not consistent with the capital usage in classification. However, it can be loosely considered that capital for production may be the closest substitute for capital usage. Therefore, this research uses the data available on capital for production as a substitute for the capital usage in industrial sectors.

The data for non-industrial sectors are not available; they are estimated from the information on investment in the China Statistical Yearbook (1993).[8] Total investment on capital construction and technical updating and transformation, with respect to 13 sectors, are as follows:

(1)agriculture,

(2)industry,

(3)geological prospecting,

(4)construction,

(5)transportation and telecommunications,

(6)commerce, food services and storage,

(7)real estate and public services,

(8)health care, sports and social welfare,

[8]In the Yearbook, in Table 5-23 "Investment in Capital Construction by Sector of National Economy and Province in 1992" and Table 5-43 "Investment in Technical Updating and Transformation by Sector of National Economy and Province in 1992".

(9)education and culture,

(10)scientific research,

(11)banking and insurance,

(12)administration,

(13)others.

According to the aggregation method of sectors in Table 6.1, sectors (3)-(13) can be simply aggregated into seven non-industrial sectors. Then we can calculate the proportions of the investment in industry to the investment in these non-industrial sectors. Furthermore, assuming that the proportions of capital stocks are the same as the proportions of investment (because the fixed capital stocks in industry are obtained previously), it then becomes possible to estimate capital stocks in non-industrial sectors. The data on the capital stocks in the agricultural sector are obtained in a different way. The Rural Statistical Yearbook of China in 1993[9] provides data on the number of rural households by province and on the capital stocks per rural household; the two sources are used to derive the capital stocks in the agricultural sector by province. Data on capital usage in agricultural and non-industrial sectors do not exist, and deriving them is impossible, because no data exists on the capital for production in these sectors. Therefore, the usage rates in agricultural and non-industrial sectors use industrial data as a reference. As the estimated utilization rates in industries are around 0.8, I assume that the utilization rate is applicable to agricultural and non-industrial sectors in all provinces.

Employment and labor resources

Information on employment and labor resources can be obtained from the provincial "Population Census in 1990". The original data in each province for employment and labor are broken down into 55 sectors and eight types of occupation, which are aggregated into 30 sectors according to the method in Table 6.1, and into four types of occupations according to the method shown in Table 6.2. As this research assumes that labor is fully employed, the sum of employment in various sectors is equal to the labor resource in each province.

[9]In the Rural Statistical Yearbook of China 1993, the Table 3-3 "Rural Households and Population by Province in 1992" has the data on the number of rural households by province, and the Table 3-24 "Original Value of Fixed Assets for Production Per Rural Household by Province" provides the information on capital stocks per rural household.

Table 6.1. Aggregations from 55 sectors to 30 sectors

No.	Original Sectors	No.	Aggregated Sectors
(1)	Agriculture	(1)	Agriculture
(2)	Coal Mining and Processing	(2)	Coal Mining and Processing
(3)	Petroleum and Natural Gas Extraction	(3)	Petroleum and Natural Gas Extraction
(4)	Ferrous Metals, Mining and Processing	(4)	Metal Mining and Processing
(5)	Nonferrous Metals, Mining and Processing		
(6)	Construction Materials	(5)	Nonmetals Mining and Processing
(7)	Salt Mining and Processing		
(8)	Other Minerals, Mining and Processing		
(9)	Logging, Transport of Timber and Bamboo		
(10)	Water Production and Supply		
(11)	Food Processing and Manufacturing	(6)	Food Manufacturing
(12)	Beverage Manufacturing		
(13)	Tobacco Processing		
(14)	Feed Industry		
(15)	Textile Industry	(7)	Textile Industry
(16)	Garments and Other Fiber Products	(8)	Sewing and Leather Products
(17)	Leather, and Other Products		
(18)	Timber, Bamboo and Other Products	(9)	Timber and Furniture Manufacturing
(19)	Furniture Manufacturing		

Table 6.1 (continued) Aggregations from 55 sectors to 30 sectors

No.	Original Sectors	No.	Aggregated Sectors
(20)	Papermaking and Paper Products	(10)	Paper Making and Stationery Goods
(21)	Printing and Record Medium		
(22)	Stationery, Educational and Other Goods		
(23)	Arts and Crafts		
(24)	Electric Power and Steam	(11)	Electric Power, Steam, etc.
(25)	Petroleum Processing	(12)	Petroleum Processing
(26)	Coking Products and Gas	(13)	Coking, Gas and Coal Products
(27)	Raw Chemicals Materials and Products	(14)	Chemical Industry
(28)	Medical and Pharmaceutical Products		
(29)	Chemical Fibers Manufacturing		
(30)	Rubber Products		
(31)	Plastic Products		
(32)	Nonmetal Mineral Products	(15)	Nonmetals Products
(33)	Smelting and Pressing of Ferrous Metals	(16)	Smelting and Pressing of Metals
(34)	Smelting and Pressing of Nonferrous Metals		
(35)	Metal Products	(17)	Metal Products
(36)	Machinery and Equipment Manufacturing	(18)	Machinery and Equipment Manufacturing
(37)	Transportation Equipment Manufacturing	(19)	Transportation Equipment Manufacturing
(38)	Electric Equipment and Machinery	(20)	Electric Equipment and Machinery

Table 6.1 (continued) Aggregations from 55 sectors to 30 sectors

No.	Original Sectors	No.	Aggregated Sectors
(39)	Electronics and Telecommunications	(21)	Electronics and Telecommunications
(40)	Instruments and Meters	(22)	Instrument and Meters
(41)	Other Manufacturing	(23)	Other Manufacturing
(42)	Geological Prospecting	(24)	Construction
(43)	Construction		
(44)	Transportation and Telecommunications	(25)	Transportation and Telecommunications
(45)	Wholesale, Retail and Trade	(26)	Commerce
(46)	Food Services		
(47)	Goods Distribution		
(48)	Storage		
(49)	Real Estate and Special Services	(27)	Social Services
(50)	Health Care, Sports and Social Welfare	(28)	Culture, Education and Research
(51)	Education, Culture, and etc.	(28)	
(52)	Scientific Research		
(53)	Banking and Insurance	(29)	Banking and Insurance
(54)	Government	(30)	Government
(55)	Others	(27)	

Table 6.2 Aggregations from eight to four types

No.	Original Types	No.	Aggregated Types
(1)	Technician	(1)	Technician
(2)	Officer	(2)	Manager
(3)	Staff		
(4)	Commercial worker	(3)	Skilled
(7)	Worker		
(5)	Servant	(4)	Unskilled
(6)	Farmer		
(8)	Others		

6.4.2 Outcomes

Depending on the exogenous variables, all endogenous variables in the model are solved. In the general equilibrium, overall domestic final use in China is maximized subject to an optimal composition of the overall final uses in provinces. Using the information, the overall final use in i province is obtained by

$$D^i = d^i D$$

Chapter 7 will present the results in detail, for they serve as a departure point for further computations of personal income distribution.

Appendix 6.A: The List of 33 Sectors in the input-output table of China

No.	Sectors	No.	Sectors
1	Agriculture	18	Machinery
2	Coal mining	19	Transport equipment
3	Crude petroleum, natural gas	20	Electric machinery, instrument
4	Metal ore mining	21	Electrical, commu. equipment
5	Other mining	22	Instruments, meters
6	Food manufacturing	23	Maintenance, repair
7	Textiles	24	Other industries
8	Wearing apparel, leather	25	Construction
9	Sawmills, furniture	26	Freight trans. and commu.
10	Paper, cultural, edu. articles	27	Commerce
11	Electrical, steam, hot water	28	Restaurants
12	Petroleum refineries	29	Passenger transport
13	Ore mining, gas, coal	30	Public utilities, services
14	Chemical industries	31	Cultural, education, health science research institute
15	Building material, non-metallic	32	Finance and insurance
16	Primary metal manufacturing	33	Public administration
17	Metal products		

Chapter 7

Income Distribution in Competitive Chinese Economy

7.1 Introduction

Chapter 4 investigated the personal income distribution in the current Chinese economy. Some results implied that it was unclear whether the problems with the current distribution of personal income were caused by the economic reform. Moreover, this question remained: if the problems are market-oriented, how would they change if the Chinese economy moved towards more competition? To answer these questions, we can best set up a hypothetical market economy. Chapter 6 presented a specific model with fixed international trade and competition between Chinese provinces and argued that this approach would reflect market economy features. This chapter will use the empirics of the model to outline the hypothetical market economy regarding China. We hope this will shed some light on the personal income distribution under perfect competition.

This chapter characterizes the market economy with economic activity, efficiency, migration and functional income distribution. It presents the results of the empirics from Chapter 6, which expose a situation on a competitive Chinese economy, in which competition has driven labor to be allocated optimally. As a result, some inefficient sectors are restricted or eliminated, and the efficient sectors are encouraged. Therefore, competition removes the inefficiency associated with the misallocation of resources in the observed economy. Consequently, because resources are valued by their marginal productivity, functional income distribution under perfect competition

is revealed.

A crucial part of this chapter is to transform functional into personal income distribution. In the switch from the current to the market economy, personal income distribution will be changed because labor and capital are paid by the efficient rental and wage rates and because migration occurs. The transformation from functional to personal income distribution proceeds with identifying capital ownership as government or private, and distinguishing the private capital holders by social classes. Capital is owned by either government or private parties. Because capital associates with production in various sectors, the shares of government and private capital may differ, and the incomes of government and private capital are very likely to be different. This chapter investigates capital ownership with respect to the agricultural sector, the sectors of industry, construction, transports and communications, and commerce, and the services sector, respectively. Although the real situation regarding capital ownership between government and private is complex, this research reasonably simplifies capital ownership as follows: all capital in the agricultural sector is owned privately, and all capital in the service sectors is owned by the government only. Meanwhile, data on capital ownership in the sectors of industry, construction, transport and telecommunications, and commerce are available from existing sources. Once capital has been separated into government and private capital (and therefore the income of private capital has been calculated), it is time to distribute capital income to private owners. This research simply ignores other potential private owners and assumes that the capitalist is the sole holder of private capital. The capitalist's income can thus be obtained. Following Chapter 4, the transformation from functional to personal income distribution further specifies the incomes of other social classes.

Chapter 4 investigated the inequality of personal income distribution in the current Chinese economy with respect to the overall inequality, the areas, the provinces and the social classes inequalities. This chapter discusses income inequality in the competitive economy in the same way. The results are therefore comparable with those in Chapter 4.

The chapter is divided into three parts. Section 7.2 describes the structure of a hypothetical market economy in China. Section 7.3 connects a bridge between the functional and the personal income distributions. The section focuses on the connecting processes. Section 7.4 discusses income distributions. The question to be answered in this section is the following: How will the income inequality be changed under perfect competition?

7.2 The competitive market

7.2.1 Economic activity

As a result of competition, some sector activities in provinces shrink or stop, while some expand. Table 7.1 shows the situation: a zero indicates inactive sectors, the figures that are less than one indicate that activities decrease in those sectors, and the figures that are greater than one show the expanded sectors. According to the table, China's gross output will increase by four percent, and gross sector outputs will increase by from two to eight percent in 27 of the 30 sectors, while they will decrease by three to five percent in the wearing apparel, the ore mining, coal and gas, and the transport equipment sectors. Moreover, gross provincial outputs will increase by up to 14 percent in 17 provinces, while they will decrease by a maximum of 19 percent in the remaining 10 provinces.

7.2.2 Efficiency

The efficiency of an economy can be decomposed into X-efficiency, allocative efficiency and trade-oriented efficiency.[1] As the trade to the rest of world is fixed in the model and labor is fully employed in the observed markets, the inefficiency for China only includes the allocative inefficiency. The results in Table 7.2 show that the overall domestic final uses are given a boost of 7% in the competitive market. Therefore, the efficiency is 93.5% in the observed economy.

Because the objective of the model is to maximize the domestic final uses, there is no certainty that the provincial final use in each province will be increased at same time. The results show that the gross final use increases in 24 of the 27 provinces, and decreases in three other provinces. But, the per capita final uses go down in 16 of the 24 provinces, and rise in the three other provinces.

7.2.3 Labor substitution and migration

Labor substitution and migration happen in all provinces when competition forces resources to be allocated optimally. Table 7.3 shows the situation. In the technician's column, a zero means the full employment of the technician in the corresponding province; a negative figure indicates the redundancy and substitution of the technician

[1]The way to decompose the efficiency was demonstrated by ten Raa (1995).

Table 7.1 **Changes of Activity in Competitive Economy**

E/O Sectors	Beijing	Tianjin	Hebei	Sanxi	Liaoning	Jilin	Heilongjiang	Shanghai	Jiangshu	Zhejiang	Anhui	Fujian	Jianxi	Sandong
1	0	1.2	1.25	0.63	1.25	1.25	1.25	1.25	0.28	1.25	0	1.25	1.25	1.25
2	1.63	0	0	1.3	0.85	1.12	1.3	0	1.29	1.25	1.32	1.42	1.3	0
3	0	0	1.17	0	1.23	1.19	1.11	0	1.15	0	0	0	0	0.96
4	1.06	0	1.27	1.45	0	0	1.29	0	0	1.34	1.37	1.23	1.35	1.24
5	1.06	1.1	1.25	1.25	1.14	0.7	0	0	1.19	0	1.24	1.38	1.4	1.19
6	1.23	0	1.19	1.31	1.17	1.18	1.21	1.17	0	0.89	1.23	1.19	0	1.22
7	1.24	0	1.25	1.35	1.23	0	0	0	1.21	1.2	1.27	0	0	1
8	1.28	1.31	0	0	1.18	0	0	1.25	0.3	1.2	0	1.24	0	1.28
9	1.31	1.7	1.31	0	1.29	1.35	1.15	1.17	1.06	0	1.25	0.36	1.28	1.23
10	1.21	1.15	1.21	0	1.19	1.22	1.23	1.17	1.21	0.4	1.19	1.19	1.23	0
11	1.08	1.14	1.08	1.11	1	1.08	1.11	1.1	1.07	0	1.08	1.1	0	1.09
12	1.15	1.11	1.16	0	1.27	1.19	1.28	1.11	0	0	1.21	0	0	1.1
13	1.07	1.03	1.18	1.29	1.12	0	1.11	1.18	0.94	1.2	0	0	1.25	1.12
14	1.21	1.25	1.18	0	1.2	1.35	1.21	0.28	1.18	1.21	1.19	0	1.23	1.19
15	1.27	1.36	1.25	1.27	1.22	0	1.21	0	1.2	0	0	0	0.59	1.22
16	1.21	0	1.17	1.23	1.74	1.15	0	1.03	1.18	1.25	0.47	0	0	1.22
17	0	1.26	1.26	1.4	1.21	0	0	1.04	1.22	1.2	1.42	0	1.3	0.54
18	0.15	1.11	1.3	0.08	1.3	1.36	0	0.92	1.24	1.22	1.3	1.35	1.34	1.27
19	1.25	1.36	1.33	0	0.47	1.26	0	0	1.25	1.21	1.37	0.11	1.33	1.3
20	0	0	1.25	1.29	1.24	0	0	0.54	1.24	1.2	1.21	1.31	1.27	1.21
21	0.39	0	1.22	0	1.19	0	0	1.12	1.17	1.21	1.28	1.19	1.21	0
22	0	0	1.3	0	0	0	0	1.18	1.28	1.25	1.28	1.29	0	1.27
23	0	0	6.56	0	0	6.37	0	0	0	2.06	2.98	6.65	0	0
24	0	0	0	1.25	1.25	1.25	1.25	0	1.25	1.25	1.25	1.25	1.25	1.25
25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0	1.25	1.25	1.25	0.22
26	1.05	1.25	1.22	1.25	0	1.25	1.25	1.25	1.13	1.25	1.25	1.25	1.07	1.25
27	0.1	0	1.25	1.25	1.25	0	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
28	1.25	1.22	1.04	1.11	1.08	0.88	1.05	1.25	0.96	0.96	1	0.93	0.92	0.88
29	1.25	1.25	0	0	0	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
30	1.21	1.21	1.1	1.13	1.04	1.15	1.07	1.18	1.05	1.05	0.85	1.09	1.08	1.04
Gross	0.86	0.85	1.23	1	1.14	1.14	1.03	0.89	0.98	1.06	0.92	1.14	0.98	1.1

Table 7.1 (continued) **Changes of Activity in Competitive Economy**

E/O Sectors	Henan	Hubei	Hunan	Guangdong	Guangxi	Shichuan	Guizhou	Yunnan	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	China
1	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0	1.25	0	1.25	0	0	1.03
2	1.35	1.36	0	0	1.41	1.44	1.36	0	1.39	1.35	1.59	0.98	1.43	1.03
3	1.11	0	0	0	0	1.21	0	0	1.12	1.22	1.17	0	1.17	1.02
4	1.24	0	0	1.39	1.31	1.41	1.33	0	1.58	1.32	1.32	1.5	1.27	1.07
5	1.19	1.21	1.24	1.19	1.25	1.36	1.31	1.45	1.3	1.35	1.6	1.18	1.4	1.08
6	1.21	1.28	1.25	1.2	0.29	1.29	1.24	1.16	1.25	1.28	1.43	0	1.22	1.04
7	1.26	1.32	1.16	1.16	0	0.51	0	1.26	1.32	0	1.38	0	1.23	1
8	1.28	1.22	0	1.17	0	0	0	0	0	0	0	0	0	0.97
9	1.28	1.3	0	1.17	1.24	1.25	1.34	1.33	1.24	1.35	1.19	1.19	1.6	1.06
10	1.21	1.26	1.22	1.23	1.2	1.22	1.16	1.19	1.23	1.26	0	1.15	0	1.04
11	1.08	1.12	1.07	1.17	1.17	1.11	1.09	1.08	1.08	1.06	1.04	1.06	1.15	1.02
12	1.16	1.3	1.22	1.2	0	0	0	0	1.2	1.14	0	1	1.1	1.04
13	1.14	0	1.2	0	1.05	1.21	1.24	0	1.22	1.57	2	1.23	1.08	0.95
14	1.18	1.24	0	1.18	1.05	1.08	1.22	1.22	1.25	1.2	0	1.25	1.34	1.05
15	1.24	1.33	1.25	1.19	1.23	1.25	1.21	1.22	0	1.32	1.29	1.29	1.34	1.05
16	1.21	1.2	1.21	1.23	0	0.27	1.19	1.29	0	1.25	1.16	1.18	1.35	1.06
17	1.22	1.29	0	1.25	0	1.32	0	1.27	1.27	1.36	1.43	1.27	1.26	1.03
18	1.29	1.31	1.34	1.28	1.32	0	0	1.33	0	1.35	0	1.32	1.48	1.07
19	0	1.22	1.33	1.24	1.27	1.27	0	0	0	0	0	0	0	0.96
20	1.25	1.23	1.29	1.17	0	1.26	0	0.66	1.29	1.39	0	1.15	1.34	1.06
21	1.14	0	1.3	1.19	0	1.31	0	1.24	1.18	1.28	0	0	0	1.02
22	0	4.08	1.38	1.25	0	1.38	0	0	1.24	0	1.67	1.53	0	1.07
23	0	0	0	0	0	0	0	0	0	0	0	7.06	0	1.1
24	1.25	0.32	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.38	1.25	1.25	1.25	1.06
25	1.25	1.25	1.25	1.25	1.25	0	1.25	1.25	1.25	1.25	1.25	1.25	0.54	1.05
26	0.19	0.35	1.25	0.18	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.03
27	1.25	1.25	1.25	0.6	1.25	1.25	1.25	1.25	1.25	1.25	0	1.25	1.25	1.03
28	0.97	0.99	0.88	1.16	0.91	0.96	0.97	1.23	0.98	1.06	0.97	1.05	1.2	1.04
29	1.25	1.25	1.25	0	1.25	1.25	1.25	0	1.25	1.25	1.25	1.25	0	1.02
30	1.07	1.01	1.06	1.1	1.08	1.06	1.09	0.85	1.13	0.9	1.06	1	1.06	1.08
Gross	1.12	1.12	1.04	1.05	1.02	1.03	1.1	0.81	1.08	0.93	1.08	0.98	0.89	1.04

Table 7.2 **Changes of Overall Final Uses in Provinces**

		Observed final uses	Observed proportions	1992 Population	Final uses per capita	Optimal final uses	Optimal proportions	Competitive Population	Final uses per capita		
		1	2	3	4 = 1/3	5	6	7	8 = 5/7	9 = 5/1	10 = 8/4
1	Shanghai	11471370	0.047	13450000	8529	13590460	0.052	11686378	11629	1.18	1,36
2	Beijing	7028548	0.029	11020000	6378	8472910	0.032	7865687	10772	1.21	1,69
3	Tianjin	4172561	0.017	9200000	4535	5069035	0.019	8915520	5686	1.21	1,25
4	Guangdong	22452701	0.092	65250000	3441	24742390	0.095	73714158	3357	1.1	0,98
5	Liaoning	12865838	0.053	40160000	3204	13392749	0.051	44714553	2995	1.04	0,93
6	Jiangshu	20059650	0.082	69110000	2903	21144454	0.081	36971300	5719	1.05	1,97
7	Zhejiang	12179228	0.050	42360000	2875	12825958	0.049	48141061	2664	1.05	0,93
8	Fujian	7965712	0.033	31160000	2556	8649233	0.033	35594715	2430	1.09	0,95
9	Sandong	21243425	0.087	86100000	2467	22191961	0.085	103237073	2150	1.04	0,87
10	Hebei	11629181	0.048	62750000	1853	12800918	0.049	74386488	1721	1.1	0,93
11	Sanxi	8146856	0.033	29790000	2735	9119255	0.035	23549829	3872	1.12	1,42
12	Heilongjiang	9578741	0.039	36080000	2655	10215016	0.039	39042822	2616	1.07	0,99
13	Jilin	5998789	0.025	25320000	2369	6890695	0.026	28410346	2425	1.15	1,02
14	Jianxi	6102867	0.025	39130000	1560	6615516	0.025	45890587	1442	1.08	0,92
15	Hunan	9539241	0.039	62670000	1522	10124246	0.039	74860874	1352	1.06	0,89
16	Henan	12451864	0.051	88610000	1405	13299109	0.051	106945609	1244	1.07	0,88
17	Hubei	7676598	0.031	55800000	1376	7743620	0.030	65667711	1179	1.01	0,86
18	Anhui	6955309	0.029	58340000	1192	5889617	0.023	11147391	5283	0.85	4,43
19	Neimeng			22070000	0			22070002	0		1

Table 7.2 (continued) **Changes of Overall Final Uses in Provinces**

		Observed final uses	Observed proportions	1992 Population	Final uses per capita	Optimal final uses	Optimal proportions	Competitive Population	Final uses per capita		
		1	2	3	4 = 1/3	5	6	7	8 = 5/7	9 = 5/1	10 = 8/4
20	Xinjiang	5862576	0.024	15810000	3708	6199487	0.024	7225453	8580	1.06	2,31
21	Qinghai	1040370	0.004	4610000	2257	1107498	0.004	5314016	2084	1.06	0,92
22	Ningxia	1062427	0.004	4870000	2182	1065243	0.004	1815493	5868	1	2,69
23	Shanxi	5859194	0.024	34050000	1721	6614473	0.025	40090128	1650	1.13	0,96
24	Guangxi	6725083	0.028	43800000	1535	7242038	0.028	52310678	1384	1.08	0,9
25	Gansu	3509788	0.014	23140000	1517	3174863	0.012	4507675	7043	0.9	4,64
26	Shichuan	16246742	0.067	109980000	1477	17165964	0.066	134130559	1280	1.06	0,87
27	Guizhou	3569005	0.015	33610000	1062	3896328	0.015	40467153	963	1.09	0,91
28	Yunnan	2475200	0.010	38320000	646	2114315	0.008	7191119	2940	0.85	4,55
29	Hainan			6860000	0			6860000	0		1
30	Tibet			2280000	0			2280001	0		1
	China	2.44E+08	1	1.166E+09	2092	2.61E+08	1.002009	1.165E+09	2239	1.07	1,07

Table 7.3 **Labor Substitution and Migration**

		Technician	Manager	Skill	Unskill	Total
1	Beijing	0	-18880	-532592	-1255984	-1807456
2	Tianjin	0	0	-365537	206990	-158547
3	Hebei	-26928	26928	0	6610557	6610557
4	Sanxi	0	0	0	-3515805	-3515805
6	Liaoning	0	-43212	10963	2643557	2611308
7	Jilin	-17447	17447	0	1756577	1756577
8	Heilongjiang	-9330	9331	-409936	2097754	1687819
9	Shanghai	0	0	-1223838	202818	-1021020
10	Jiangshu	0	0	-646014	-17553709	-18199723
11	Zhejiang	0	-189	189	3301172	3301172
12	Anhui	0	-29213	29210	-26523541	-26523544
13	Fujian	-4884	4884	0	2495875	2495875
14	Jianxi	-10923	10923	0	3802483	3802483
15	Sandong	-45590	45590	0	9803246	9803246
16	Henan	0	-7886	7886	10329699	10329699
17	Hubei	0	0	0	5570242	5570242
18	Hunan	-26048	26048	0	6886476	6886476
19	Guangdong	0	-26833	26833	4757735	4757735
20	Guangxi	-14820	14820	0	4790687	4790687
22	Shichuan	-18005	18005	-412573	14125543	13712970
23	Guizhou	-7450	7450	0	3856868	3856868
24	Yunnan	0	-40025	40025	-17528785	-17528785
26	Shanxi	-7465	7465	-37648	3442003	3404355
27	Gansu	0	-17063	17063	-10512968	-10512968
28	Qinghai	-753	753	-2584	399822	397238
29	Ningxia	0	-4621	4621	-1704259	-1704259
30	Xinjiang	0	-23685	23685	-4803195	-4803195
	China	-189631	-21959	-3470240	3681858	5

for the manager. In the manager's column, a zero means the full employment of the manager in the corresponding province; a negative figure indicates the redundancy and substitution of the manager for skilled labor. In addition, the positive figure shows how many manager positions have been substituted by technician. The same meaning is also applied to the column of skilled worker. A positive figure in the column of unskilled worker represents a combined result of both the substitution of skilled labor for unskilled labor and the migration of unskilled labor from other provinces. A negative figure shows the redundancy and immigration of unskilled labor by province. The last column shows the immigration and migration of unskilled worker by negative and positive signs.

In the twelve provinces of Hebei, Jilin, Heilongjiang, Fujian, Jiangxi, Sandong, Hunan, Guangxi, Shichuan, Guizhou, Shanxi, and Qinghai, redundant technicians substitute for managers. In the provinces of Beijing, Liaoning, Zhejiang, Anhui, Henan, Guangdong, Yunnan, Gansu, Ningxia and Xinjiang, redundant managers substitute for skilled labor. In the provinces of Beijing, Tianjin, Heilongjiang, Shanghai, Jiangshu, Shichuan, and Qinghai, some skilled labor is redundant, and substitute for unskilled labor. In total, the provinces of Beijing, Tianjin, Sanxi, Shanghai, Jiangshu, Anhui, Yunnan, Gansu, Ningxia, and Xinjiang have immigration, while other provinces face migration.

The immigration and migration between provinces causes the population to change. Some dependants will of course migrate outward or inward together with the unskilled immigrants or migrants according to the dependency ratios. After this adjustment, the population in the competitive economy is obtained, which is presented in Table 7.4.

7.2.4 Functional income distribution

The important information from the results is about the rental and wage rates. The rental rates, together with the prices of tradable and non-tradable commodities, are listed in Table 7.5. Given the prices and employment of sector capital, capital income is obtained by multiplying the rental rates in Table 7.5 with the employed capital in Table 7.6. The capital income may be separated into three categories by sectors: in the agricultural sector, in the sectors of industry, construction, transports and communications, and commerce, and in the sectors of public service, culture and education, finance and insurance, and administration.

Table 7.4 **Population (estimated) in Competitive Chinese Economy**

The Eastern Part

		SH	BJ	JS	TJ	LN	FJ	GD	ZJ	HB	SD
1	Rural unskilled	1185275	210693	7791405	1239080	11422237	11969063	21953656	14350037	31948547	42501547
2	Rural skilled	1132311	210720	6139333	99331	513357	1454591	1315722	3057086	1	1
3	Rural manager	78436	48347	574097	26029	123999	82068	123166	148768	155758	240941
4	Rural technician	164136	84921	998949	53553	376870	361027	412358	398194	555172	818865
5	Rural self-employed	104140	160865	1101917	95743	439673	400015	1173421	1456627	50622	65896
6	Rural capitalist	4389	599	6507	6649	6364	7085	27492	16911	14784	13390
7	Rural retiree	148256	33114	483125	17375	167245	140144	281656	178704	273196	341026
8	Rural dependant	1140030	880497	8845389	1227014	9345053	13883568	21617659	13431701	26379658	29864061
	Rural population	3956973	1629756	25940722	2764774	22394798	28297561	46905130	33038028	59377738	73845727
1	Urban unskilled	657615	200078	611318	805930	3239764	1179247	5203286	3103972	2458399	8275256
2	Urban skilled	2507280	2115179	5030426	1897191	6563843	1723650	6922593	4480749	5065001	7611000
3	Urban manager	282542	359293	636791	191157	659904	133151	449360	262804	378354	488833
4	Urban technician	887704	976299	1275515	594503	1597975	489642	1474988	915195	1006866	1472741
5	Urban self-employed	79090	117804	210288	46516	472894	242530	763701	283895	183928	296721
6	Urban capitalist	11601	15360	16385	9342	19782	54533	73095	17086	6093	16080
7	Urban retiree	1350286	724366	1110513	510376	1592882	329770	1049934	655528	542809	731107
8	Urban dependant	1953287	1727552	2139342	2095731	8172711	3144631	10872071	5383804	5367300	10499608
	Urban population	7729405	6235931	11030578	6150746	22319755	7297154	26809028	15103033	15008750	29391346
	Total population	11686378	7865687	36971300	8915520	44714553	35594715	73714158	48141061	74386488	103237073

Table 7.4 (continued) **Population (estimated) in Competitive Chinese Economy**

		The Middle Part									
		AH	HLJ	SX	JL	HuN	JX	HeN	HuB	NM	China
1	Rural unskilled	633620	9909543	6009540	8532852	33480225	18491633	51159429	26195374	6707771	437589620
2	Rural skilled	448528	380314	102523	207596	754859	670381	409094	407533	275091	18123957
3	Rural manager	148904	110367	93304	61710	163297	116789	251512	151390	61229	3379169
4	Rural technician	547337	349130	338984	237649	591800	440643	993937	528277	240144	11403838
5	Rural self-employed	773824	152295	587676	162505	782226	590272	901166	654851	193310	12828381
6	Rural capitalist	3019	380	11717	1004	5846	3256	8231	1387	1662	167139
7	Rural retiree	194696	165499	144714	57175	335698	202132	320295	168436	60748	5043517
8	Rural dependant	2677524	9980460	8281740	7568458	25668365	16272207	37088316	19222543	6510231	358603327
	Rural population	5427452	21047988	15570198	16828949	61782316	36787313	91131980	47329791	14050186	847138948
1	Urban unskilled	41911	2393938	702864	1346841	2522700	1582000	2992440	3592405	1024358	53415761
2	Urban skilled	3177066	4072299	2831961	2966746	3241758	2162283	4121962	4856273	1954824	90250222
3	Urban manager	263624	532688	278229	310473	342009	200850	412639	438275	201952	8329509
4	Urban technician	758249	1233147	729725	844227	910618	586240	1074306	1288476	617411	23788515
5	Urban self-employed	409499	464219	154958	336786	367627	312093	368858	279548	230212	7402016
6	Urban capitalist	3326	9230	4615	4778	6902	3754	3943	4995	4117	331993
7	Urban retiree	494470	982098	324393	616772	620861	384179	566840	785556	346321	17088007
8	Urban dependant	571794	8307215	2952886	5154774	5066083	3871875	6272641	7092392	3640621	117259408
	Urban population	5719939	17994834	7979631	11581397	13078558	9103274	15813629	18337920	8019816	317865431
	Total population	11147391	39042822	23549829	28410346	74860874	45890587	106945609	65667711	22070002	1165004379

Table 7.4 (continued) **Population (estimated) in Competitive Chinese Economy**

The Western Part

		XJ	NX	GS	YN	QH	ShX	HN	GX	TB	SC	GZ
1	Rural unskilled	278586	69841	232825	326891	2038581	16786979	2314405	23920544	894046	66750683	18284712
2	Rural skilled	107696	1	1	79705	87125	16384	203049	1	43601	1	8021
3	Rural manager	42228	11373	49898	68186	14832	76783	16845	95072	12863	177473	53505
4	Rural technician	195241	48059	198365	376764	78722	342504	78775	390461	49155	919208	234638
5	Rural self-employed	174221	36245	75319	397675	28951	407374	66887	221787	14862	1361433	196583
6	Rural capitalist	1479	469	2280	1394	361	4333	894	3660	1	7410	4186
7	Rural retiree	125893	11665	37435	162615	13518	124473	108280	121342	8249	543396	73417
8	Rural dependant	2673078	767171	1183815	2657455	1732360	13973217	2428165	19852129	994629	38386922	14069912
	Rural population	3598422	944824	1779938	4070685	3994450	31732047	5217300	44604996	2017406	108146526	32924974
1	Urban unskilled	31385	5616	20692	21557	138695	1274529	256836	1109338	33059	6723328	1866404
2	Urban skilled	1294436	380527	1514653	1625301	334029	2235999	282638	1955507	43655	5986017	1295376
3	Urban manager	126808	35091	136291	107365	37636	239118	37609	202256	8748	440070	135589
4	Urban technician	431537	121541	413526	499169	105793	703237	125216	515987	25424	1690866	422392
5	Urban self-employe	185482	27034	105429	142059	40952	179326	91127	313935	25863	483389	186253
6	Urban capitalist	2900	1376	2844	1331	563	3030	14529	8002	16	7721	4664
7	Urban retiree	328993	56073	194864	306219	53891	387123	62107	325262	10706	1385758	257950
8	Urban dependant	1225490	243411	339438	417433	608007	3335719	772638	3275395	115124	9266884	3373551
	Urban population	3627031	870669	2727737	3120434	1319566	8358081	1642700	7705682	262595	25984033	7542179
	Total population	7225453	1815493	4507675	7191119	5314016	40090128	6860000	52310678	2280001	134130559	40467153

Table 7.5 **Rental Rates and Prices**

Sectors	Tradable	-tradable	BJ	TJ	HB	SX	LN	JL	HLJ	SH	JS	ZJ	AH	FJ
1	0.633	17.387	0.000	0.000	0.009	0.000	0.014	0.024	0.002	0.052	0.000	0.005	0.000	0.028
2	0.945	28.140	0.125	0.000	0.000	0.337	0.000	0.000	0.122	0.000	0.132	0.020	0.129	0.124
3	0.722	34.175	0.000	0.000	0.129	0.000	0.161	0.159	0.478	0.000	0.183	0.000	0.000	0.000
4	0.878	14.884	0.906	0.000	0.750	0.578	0.000	0.000	0.013	0.050	0.000	0.181	0.545	0.301
5	0.714	26.519	0.019	0.050	0.458	0.083	0.151	0.000	0.000	0.000	0.360	0.000	19.823	0.425
6	0.665	20.275	0.174	0.000	0.193	0.072	0.038	0.065	0.024	0.842	0.000	0.000	0.167	0.035
7	0.774	20.953	0.134	0.000	0.166	0.036	0.006	0.000	0.000	0.000	0.272	0.172	0.083	0.000
8	0.780	17.596	0.160	0.240	0.000	0.000	0.272	0.000	0.000	105.314	0.000	0.523	0.000	0.054
9	10.262	41.361	14.961	0.954	0.512	0.000	15.836	0.160	0.000	22.156	15.577	0.000	17.124	0.000
10	0.810	32.824	0.256	0.005	0.124	0.000	0.051	0.477	0.005	0.152	0.543	0.000	0.395	0.011
11	0.724	17.747	0.122	0.049	0.055	0.049	0.000	0.047	0.010	0.056	0.176	0.000	0.071	0.088
12	0.640	13.235	0.010	0.375	0.000	0.000	0.092	0.051	0.058	0.040	0.000	0.000	0.061	0.000
13	11.132	15.773	0.016	0.033	0.819	13.099	0.209	0.000	0.354	0.188	0.000	0.301	0.000	0.000
14	0.721	14.804	0.151	0.095	0.078	0.000	0.064	0.241	0.181	0.000	0.186	0.205	0.245	0.000
15	0.762	13.348	0.074	0.275	0.431	0.154	0.290	0.000	0.014	0.000	0.083	0.000	0.000	0.000
16	0.707	27.403	0.339	0.000	0.032	0.157	0.024	0.000	0.000	0.141	0.142	0.072	0.000	0.000
17	0.787	30.457	0.000	0.261	0.539	0.934	0.327	0.000	0.000	0.000	0.431	0.219	0.875	0.000
18	0.883	28.262	0.000	0.097	0.181	0.000	0.100	0.084	0.000	0.000	0.359	0.481	0.359	0.144
19	0.894	14.764	0.439	0.745	0.100	0.000	0.000	0.452	0.000	0.000	0.192	0.312	0.276	0.000
20	0.775	19.840	0.000	0.000	0.422	0.003	0.050	0.000	0.000	0.000	0.245	0.016	0.199	0.088
21	0.958	17.455	0.000	0.000	0.259	0.000	0.024	0.000	0.000	0.226	0.304	0.945	13.697	12.166
22	0.979	27.967	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.090	0.246	10.653	11.478	0.262
23	0.496	18.279	0.000	0.000	0.428	0.000	0.000	0.192	0.000	0.000	0.000	0.000	20.384	0.110
24	0.789	13.159	0.000	0.000	0.000	0.154	0.026	0.071	0.292	0.000	0.412	0.459	0.461	0.087
25	0.800	18.643	0.013	0.151	0.056	0.100	0.067	0.099	0.035	0.560	0.044	0.000	0.000	0.101
26	0.894	15.237	0.000	0.118	0.000	0.160	0.000	0.023	0.073	0.039	0.000	0.003	0.074	0.315
27	0.711	19.487	0.000	0.000	0.020	0.016	0.010	0.000	0.001	0.083	0.022	0.019	0.059	0.042
28	36.160		0.116	0.000	0.000	0.000	0.000	0.000	0.000	0.138	0.000	0.000	0.000	0.000
29	0.912		11.372	73.624	0.000	0.000	0.000	0.249	0.186	19.237	0.126	0.257	0.476	0.646
30			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7.5 (continued)

Rental Rates and Prices

Sectors	JX	SD	HN	HuB	HuN	GD	GX	SC	GZ	YN	ShX	GS	QH	NX	XJ
1	0.011	0.009	0.008	0.019	0.008	0.034	0.015	0.006	0.005	0.000	0.000	0.000	0.003	0.000	0.000
2	0.227	0.000	0.259	0.321	0.000	0.000	0.043	0.020	0.468	0.000	0.039	0.122	0.268	0.000	0.098
3	0.000	0.000	0.102	0.000	0.000	0.000	0.000	0.007	0.036	0.000	0.956	0.079	0.045	0.000	0.103
4	0.048	0.179	0.654	0.000	0.000	0.061	0.034	0.159	0.149	0.000	0.740	0.421	0.061	0.207	0.079
5	0.534	0.245	0.390	0.091	0.122	0.125	0.253	0.132	0.324	0.068	0.024	0.266	0.347	0.446	0.359
6	0.000	0.182	0.228	0.233	0.446	0.143	0.000	0.190	0.655	0.294	0.398	0.148	0.119	0.000	0.114
7	0.000	0.000	0.276	0.101	0.000	0.120	0.000	0.000	0.000	0.033	0.074	0.000	0.103	0.000	0.288
8	0.000	0.067	0.197	0.000	0.000	0.308	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.960	0.100	0.561	0.605	0.000	0.656	13.423	16.156	0.182	0.175	0.560	0.415	0.036	0.210	0.338
10	0.125	0.000	0.393	0.119	0.187	0.129	0.029	0.084	0.000	0.066	0.030	0.018	0.000	0.058	0.000
11	0.000	0.033	0.081	0.071	0.065	0.136	0.117	0.106	0.077	0.024	0.065	0.070	0.039	0.079	0.044
12	0.000	0.027	0.108	0.183	0.102	0.029	0.000	0.000	0.000	0.000	0.086	0.076	0.000	137.863	0.251
13	0.640	0.097	0.858	0.000	0.472	0.000	0.344	0.777	37.829	0.000	0.530	11.623	17.750	0.642	0.551
14	0.079	0.243	0.116	0.055	0.000	0.272	0.000	0.000	0.083	0.026	0.034	0.056	0.000	0.081	0.282
15	0.000	0.021	0.524	0.067	0.104	0.162	0.268	0.294	0.048	0.054	0.000	0.185	0.138	0.078	0.149
16	0.000	0.050	0.145	0.094	0.138	0.169	0.000	0.000	0.009	0.056	0.000	0.064	0.159	0.019	0.241
17	0.133	0.000	0.144	0.176	0.000	0.276	0.000	0.259	0.000	0.218	0.104	0.065	0.098	0.531	0.418
18	0.160	0.558	0.324	0.034	0.252	0.404	0.103	0.000	0.000	0.057	0.000	0.020	0.000	0.081	0.008
19	0.636	0.574	0.000	0.219	0.183	0.120	0.044	0.306	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.160	0.927	0.215	0.084	0.001	0.337	0.000	0.089	0.000	0.000	0.026	0.058	0.000	0.069	0.128
21	0.300	0.000	0.305	0.000	0.034	0.692	0.000	0.175	0.000	0.007	0.276	0.010	0.000	0.000	0.000
22	0.000	0.796	0.000	0.000	19.467	0.292	0.000	0.058	0.000	0.000	0.014	0.000	0.100	0.010	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.000
24	23.667	0.332	0.324	0.000	0.742	0.037	0.062	0.368	0.241	0.012	0.046	0.000	0.403	0.080	0.635
25	0.088	0.000	0.146	0.028	0.092	0.013	0.021	0.000	0.288	0.004	0.080	0.057	0.080	0.030	0.000
26	0.000	0.077	0.000	0.000	0.086	0.000	0.288	0.123	0.134	0.018	0.001	0.514	0.289	0.132	12.437
27	0.032	0.037	0.068	0.014	0.007	0.000	0.040	0.023	0.062	0.000	0.007	0.036	0.000	0.013	0.034
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.462	0.245	0.404	0.025	0.047	0.000	0.102	0.378	0.267	0.000	0.298	0.228	0.349	0.022	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7.6 **Capital Employment in Competitive Economy**

Sectors	Beijing	Tianjin	Hebei	Sanxi	Liaoning	Jilin	Heilongjiang	Shanghai	Jiangshu	Zhejiang
1	0	3355328	47518200	10088441	19806700	13114200	16792400	3526300	10369636	32618000
2	110000	0	0	2582300	709668	289307	1213800	0	402100	52300
3	0	0	960400	0	1382800	493700	2644700	0	103800	0
4	12500	0	166000	25300	0	0	94800	0	0	45800
5	146000	123100	166300	78400	367000	221580	0	0	322700	0
6	332300	0	478700	170600	562500	420500	705300	369900	0	451334
7	261000	0	788300	168700	616700	0	0	0	2064300	1177500
8	107100	92600	0	0	138700	0	0	204400	74227	220800
9	53600	27500	42200	0	45800	96000	200247	53000	68800	0
10	273800	2134500	293000	0	278500	215000	237700	321700	364100	103701
11	742700	619400	1818500	1517500	1400795	1055200	897000	901600	1200400	0
12	535500	50600	133076	0	709400	94200	824100	220400	0	0
13	188400	90600	66600	141000	138800	0	42100	167700	46045	21100
14	406400	692400	952700	0	1777600	909600	422600	326048	2685900	726600
15	414800	231100	798800	295800	1108600	0	514100	0	1242300	0
16	663900	0	884700	750600	3977700	268887	0	3468100	639500	192000
17	0	146300	157800	70500	223800	0	0	251105	353900	189000
18	64386	422800	669000	28522	1559400	336700	0	980889	1494900	693700
19	343500	151900	243200	0	208467	541900	0	0	474100	148400
20	0	0	127300	80800	439900	0	0	168078	461800	254100
21	81804	0	104500	0	216900	0	0	378700	576200	146100
22	0	0	23000	0	0	0	0	106400	137500	56500
23	0	0	1042400	0	0	271200	0	0	0	131367
24	0	0	0	565400	2497300	502500	715600	0	950100	478200
25	3607700	1022600	1844800	1968100	4707800	1172900	4001900	3926800	5755300	0
26	1978865	984500	1852192	616100	0	1473700	3868500	2960800	3840925	3178200
27	1343847	0	5360200	1279600	13282700	0	4843500	45477300	12585200	6314800
28	22083700	1804818	6096874	2943405	11486786	3266058	5558012	9896800	9567804	6725157
29	525000	36600	0	0	0	1257300	2366800	479400	1281600	769800
30	10311695	545026	3992674	1200635	5960864	2980170	7960712	3066821	7289190	3935168
Total	44588497	12531672	76581415	24571704	73605180	28980602	53903871	77252240	64352327	58629628

Table 7.6 (continued) **Capital Employment in Competitive Economy**

Sectors	Anhui	Fujian	Jianxi	Sandong	Henan	Hubei	Hunan	uangdong	Guangxi	Shichuan
1	0	22849500	27657600	63222900	67699900	35492500	46377400	49780300	33719900	82488600
2	763100	63700	235900	0	867900	69200	0	0	100300	676900
3	0	0	0	2164303	1380300	0	0	0	0	606400
4	24900	16500	369200	228300	97100	0	0	133700	156000	164300
5	91000	129600	79000	374800	100900	255200	163700	422200	74800	347800
6	474700	407300	0	1295600	606700	548700	424200	1501300	133889	801000
7	430400	0	0	1159962	602400	865200	303077	1336700	0	256876
8	0	151200	0	220100	110300	107623	0	661000	0	0
9	38300	28266	52700	110900	38000	57600	0	218200	38400	63500
10	154100	244300	127100	0	259000	215600	253200	807700	138100	316800
11	647200	540700	0	1514000	1098900	1305700	1118000	1972600	444700	1550800
12	130900	0	0	933500	165200	134500	268400	466800	0	0
13	0	0	14100	95400	59700	0	12700	0	4400	39900
14	476400	0	307900	1384700	980700	660100	0	1280100	250755	1062207
15	0	0	159212	1268600	677100	604800	588300	1958500	388400	731500
16	229365	0	0	570100	508500	1366800	500200	453200	0	360965
17	65600	0	35500	115964	90000	144400	0	388900	0	177900
18	333900	190000	253800	1084700	901400	632600	565600	706700	225100	0
19	108200	5556	150500	337200	0	799800	242400	372300	111600	509300
20	109500	96500	75100	252000	188900	160100	167900	855100	0	263300
21	50300	108800	71600	0	138900	0	83400	849900	0	276600
22	19300	11100	0	37600	0	23692	29600	33900	0	115700
23	54000	1173100	0	0	0	0	0	0	0	0
24	684100	878400	55800	511100	701800	220947	476300	1271800	444700	1033600
25	1297900	2038800	972200	1436259	2103800	3200200	2595100	18811400	1568600	0
26	660700	882900	437433	5283000	336643	656614	2134600	463317	852600	3393900
27	2460000	4346500	1558500	11008100	4220600	3980900	4845800	11825501	2517000	9542700
28	3097313	2722302	1911487	11881322	4531972	6448875	5201242	15058378	3034450	10576156
29	533000	556400	627600	2558700	1030900	1225900	1510000	0	903400	1707800
30	1134216	2186805	1628095	8104956	2962247	3513539	4350071	9372997	2814717	6907851
Total	14068395	39628228	36780327	1.17E+08	92459762	62691091	72211189	1.21E+08	47921811	1.24E+08

Table 7.6 (continued) **Capital Employment in Competitive Economy**

Sectors	Guizhou	Yunnan	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Gross
1	25503400	0	24033200	0	2893000	0	0	638907405
2	251700	0	337400	194300	24400	141824	145200	9231299
3	0	0	95800	341100	139000	0	1250900	11563203
4	12900	0	138700	31700	39100	600	56400	1813800
5	66400	164900	81800	65400	36200	10000	67800	3956580
6	253400	539900	240200	140500	38600	0	241500	11138624
7	0	87600	365300	0	36300	0	283800	10804115
8	0	0	0	0	0	0	0	2088051
9	9800	41300	25200	11300	4300	3200	14200	1342313
10	41322	95400	123000	60600	0	28600	0	7086823
11	357200	744900	848000	582300	300000	249300	474000	23901395
12	0	0	25600	154000	0	200	109600	4955976
13	2600	0	25700	5500	200	5800	8000	1176345
14	188300	362600	323300	483500	0	59000	87900	16807309
15	190200	236300	0	229200	38700	79600	189300	11945212
16	464900	394600	0	852400	162900	100800	135700	16945817
17	0	30800	71400	37000	12000	8100	15300	2585268
18	0	219100	0	219100	0	93000	94400	11769697
19	0	0	0	0	0	0	0	4748323
20	0	22421	148700	61100	0	5400	16000	3953999
21	0	17300	320200	44300	0	0	0	3465504
22	0	0	107800	0	2500	13200	0	717792
23	0	0	0	0	0	276100	0	2948167
24	131000	394100	944600	149065	81600	125200	315700	14128912
25	359900	1910700	902700	1012200	289900	405500	362733	67275792
26	488800	1411000	1405500	513000	164200	314300	496700	40648989
27	712900	3131600	1906300	1378500	0	532300	759900	155214248
28	1193776	4871632	5322629	2056311	512840	599531	1579955	160029584
29	317500	0	917200	478400	99500	240000	0	19422800
30	1377479	2902772	1802998	955084	490606	499957	1309081	99556425
Total	31923476	17578925	40513227	10055860	5365846	3791511	8014069	1360129765

Let IK_s^j denote capital income, where $j = 1, ..., 27$ represents provinces and $s = 1, ..., 30$ represents sectors. Let K and γ denote employed capital and rental rates, as in the previous chapter. Let a represent the agricultural sector, b the sectors of industry, construction, transports and communications, and commerce, and c the sectors of public service, culture and education, finance and insurance, and administration. Then, the results on capital income presented in Table 7.7 are obtained through the calculations below.

Capital income in the agricultural sector is

$$IK_a^j = \sum_{s=1}^{1} K_s^j \gamma_s^j.$$

Capital income in the sectors of industry, construction, transports and communications, and commerce is

$$IK_b^j = \sum_{s=2}^{26} K_s^j \gamma_s^j.$$

Capital income in the sectors of public service, culture and education, finance and insurance, and administration is

$$IK_c^j = \sum_{s=27}^{30} K_s^j \gamma_s^j.$$

After the model is solved, the results directly include the unskilled wage and the wage premiums of the technician, the manager and the skilled. The wage of skilled labor is the sum of their premiums and the unskilled wage:

$$\Omega_{skilled}^j = \omega_{unskilled}^j + \omega_{skilled}^j$$

The manager's wage is the sum of their premiums and the skilled wage:

$$\Omega_{manager}^j = \Omega_{skilled}^j + \omega_{manager}^j$$

The technician's wage is the sum of their premiums and manager's wage:

$$\Omega_{technician}^j = \Omega_{manager}^j + \omega_{technician}^j$$

The results are presented in Table 7.8.

Table 7.7 **Capital Income in Competitive Economy**

Sectors	Beijing	Tianjin	Hebei	Sanxi	Liaoning	Jilin	Heilongjiang	Shanghai	Jiangshu	Zhejiang	Anhui	Fujian	Jianxi
1	0	0	436692	0	274917	317101	39798	181957	0	148738	0	644584	295383
2	13770	0	0	869435	0	0	147719	0	52985	1050	98470	7912	53547
3	0	0	123988	0	222271	78553	1265039	0	18984	0	0	0	0
4	11330	0	124442	14629	0	0	1247	0	0	8271	13570	4962	17666
5	2790	6112	76222	6467	55333	0	0	0	116275	0	180386	55054	42147
6	57684	0	92432	12355	21341	27404	16659	311345	0	0	79099	14186	0
7	35081	0	131055	6031	3386	0	0	0	560581	202554	35702	0	0
8	17138	22181	0	0	37774	0	0	2152618	0	115485	0	8160	0
9	80188	26240	21613	0	72528	15390	0	117427	107170	0	65584	0	50575
10	70109	9861	36449	0	14103	102620	1272	48802	197859	0	60873	2614	15851
11	90446	30165	100345	73887	0	49858	9230	50490	211318	0	46210	47603	0
12	5451	18997	0	0	65300	4844	48062	8706	0	0	7978	0	0
13	2932	2993	54513	184693	29005	0	14892	31494	0	6357	0	0	9020
14	61143	66000	74282	0	113944	219150	76343	0	500679	148662	116890	0	24373
15	30849	63460	344411	45396	321782	0	7300	0	103074	0	0	0	0
16	225208	0	28417	117852	96658	0	0	489002	90764	13791	0	0	0
17	0	38130	85100	65834	73062	0	0	0	152432	41414	57414	0	4724
18	0	40788	121196	0	155659	28417	0	0	535862	333399	119837	27398	40479
19	150786	113134	24301	0	0	244646	0	0	90894	46307	29888	0	95762
20	0	0	53768	250	22004	0	0	0	113076	4086	21788	8523	12036
21	0	0	27082	0	5242	0	0	85666	175274	138006	68895	132369	21476
22	0	0	55	0	0	0	0	9620	33835	60190	22152	2913	0
23	0	0	446095	0	0	51959	0	0	0	0	110075	129006	0
24	0	0	0	86959	64780	35783	209027	0	391403	219618	315035	75982	132061
25	45637	154709	104010	197676	317306	116551	140867	2199361	253118	0	195	205022	85583
26	0	116023	0	98742	0	33969	281627	115797	0	10361	48865	277681	0
27	0	0	109187	20205	135218	0	5812	3791443	280902	121118	146149	183162	49591
28	2550888	0	0	0	0	0	0	1366649	0	0	0	0	0
29	597009	269465	0	0	0	313457	440698	922236	161084	197908	253532	359484	289625
30	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4048440	978258	2615653	1800411	2101613	1639702	2705592	11882612	4147570	1817316	1898586	2186614	1239899

Table 7.7 (continued) **Capital Income in Competitive Economy**

Sectors	Sandong	Henan	Hubei	Hunan	Guangdong	Guangxi	Shichuan	Guizhou	Yunnan	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang
1	561419	509103	669389	384932	1665151	514566	450388	132363	0	8892	0	8014	0	0
2	0	224968	22219	0	0	4327	13342	117899	0	13256	23639	6537	0	14186
3	0	140528	0	0	0	0	3917	0	0	91570	26926	6206	0	128968
4	40886	63519	0	0	8084	5329	26079	1916	0	102669	13359	2385	124	4433
5	91744	39297	23323	20003	52788	18952	45875	21528	11144	1981	17387	12570	4459	24354
6	235747	138243	127907	189189	214506	0	152182	166020	158563	95604	20776	4595	0	27408
7	0	166286	87428	0	159923	0	0	0	2920	27050	0	3750	0	81715
8	14648	21702	0	0	203376	0	0	0	0	0	0	0	0	0
9	11079	21313	34856	0	143082	51544	102590	1785	7226	14123	4687	154	670	4803
10	0	101792	25624	47272	104209	3959	26513	0	6253	3648	1108	0	1656	0
11	50265	89000	92235	72950	268353	52119	164121	27644	17878	55290	40732	11721	19620	21022
12	25298	17767	24634	27337	13421	0	0	0	0	2197	11624	0	2757	27472
13	9213	51214	0	6000	0	1515	31017	9836	0	13615	6393	355	3722	4408
14	335831	113889	36372	0	348699	0	0	15595	9424	10960	26936	0	4750	24824
15	26729	354834	40249	61107	316552	104045	214834	9194	12862	0	42413	5357	6177	28211
16	28317	73529	128534	68933	76586	0	0	4012	21963	0	54826	25895	1895	32660
17	0	12979	25456	0	107189	0	46003	0	6718	7443	2401	1180	4297	6390
18	604785	292135	21559	142610	285804	23082	0	0	12449	0	4421	0	7552	724
19	193624	0	174748	44451	44777	4898	155647	0	0	0	0	0	0	0
20	233501	40604	13437	160	287929	0	23494	0	0	3924	3536	0	372	2050
21	0	42359	0	2852	588250	0	48413	0	126	88414	421	0	0	0
22	29913	0	0	57622	9882	0	6698	0	0	1471	0	249	133	0
23	0	0	0	0	0	0	0	0	0	0	0	0	7620	0
24	169859	227671	0	353524	47324	27683	380499	31558	4560	43055	0	32907	9991	200432
25	0	308059	91014	237841	235707	33129	0	103594	8216	72252	57169	23099	12287	0
26	407425	0	0	182722	0	245898	418841	65533	24735	1138	263667	47526	41425	617736
27	410272	285059	55693	32225	0	101410	221391	44300	188	13497	50067	0	7026	25479
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	626626	416401	30929	71423	0	92129	644609	84677	0	273252	108855	34678	5376	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4107180	3752252	1725606	2003152	5181590	1284584	3176454	837453	305225	945303	781345	227178	141909	1277275

Table 7.8

Wage Premiums and Rates in Competitive Economy

		BJ	TJ	HB	SX	LN	JL	HLJ	SH	JS	ZJ	AH	FJ	JX	SD
Technician	w1	5.651	3.573	0.000	0.475	6.076	0.000	0.000	4.771	2.991	5.610	2.065	0.000	0.000	0.000
Manager	w2	0.000	2.071	3.425	1.933	0.000	2.375	3.331	1.146	3.114	0.000	0.000	2.794	2.276	3.297
Skilled	w3	0.000	0.000	0.349	0.151	0.000	0.062	0.000	0.000	0.000	0.311	0.216	0.508	0.204	0.451
Unskilled	w4	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Technician	w1+w2+w3+w4	5.686	5.679	3.811	2.595	6.112	2.472	3.367	5.953	6.141	5.957	2.316	3.338	2.516	3.784
Manager	w2+w3+w4	0.036	2.107	3.811	2.120	0.036	2.472	3.367	1.182	3.150	0.347	0.251	3.338	2.516	3.784
Skilled	w3+w4	0.036	0.036	0.385	0.186	0.036	0.098	0.036	0.036	0.036	0.347	0.251	0.544	0.240	0.487
Unskilled	w4	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036

Wage Premiums and Rates in Competitive Economy

		HeN	HuB	HuN	GD	GX	SC	GZ	YN	ShX	GS	QH	NX	XJ
Technician	w1	2.182	1.802	0.000	9.915	0.000	0.000	0.000	1.263	0.000	3.081	0.000	4.077	4.432
Manager	w2	0.000	0.742	3.375	0.000	2.665	3.602	1.967	0.000	3.245	0.000	3.116	0.000	0.000
Skilled	w3	0.339	0.081	0.095	0.093	0.355	0.000	0.211	0.129	0.000	0.170	0.000	0.131	0.107
Unskilled	w4	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Technician	w1+w2+w3+w4	2.556	2.661	3.506	10.043	3.055	3.638	2.213	1.427	3.281	3.287	3.152	4.243	4.574
Manager	w2+w3+w4	0.374	0.859	3.506	0.128	3.055	3.638	2.213	0.165	3.281	0.206	3.152	0.166	0.142
Skilled	w3+w4	0.374	0.117	0.131	0.128	0.391	0.036	0.246	0.165	0.036	0.206	0.036	0.166	0.142
Unskilled	w4	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036

7.3 Personal income distribution under perfect competition

7.3.1 The government and private capital

When the model was built in Chapter 6, it was not necessary to specify capital ownership, because only capital inputs and endowments mattered there. But, when the functional income distribution needs to be transformed into the personal income distribution, capital ownership becomes important, because the ownership of capital contributes capital income to the relevant capital owners. Capital is owned either by the government or by private parties. In China, the government owns the majority of capital. Capital income is her direct income (as opposed to indirect income such as taxation, charges and borrows). The capital income of the government may be used for investment, government consumption, and redistributive transfers. In primary distribution, the government has no income from wages; capital income is her sole income source. Comparatively, private parties may have both labor and capital income. In practice, it is also less likely to specify capital with respect to capital types at the individual level, because of the great variety of capital types and the lack of information on capital holders. However, this research does not need to trace capital ownership to such a detailed extent that capital are specified perfectly. What this research is concerned with is to distinguish capital into government and private capital, and to specify the capitalist as the sole holder of private capital. Once the functional income of capital has been separated into government and private income, it becomes possible to derive the capitalists' average income by dividing private capital income over the number of capital holders. Because capital is sector specific in this research, capital ownership is also different across sectors.

In the agricultural sector, all capital is owned privately by farmers, who, however, are not capitalists. The rural capitalists, in fact, are those who hold their capital in sectors such as industry, commerce and construction (but not in the agricultural sector). Capital income in the agricultural sector is distributed to all farmers who hold own capital, whereas the rural capitalist receives rents from other non-agricultural sectors. At present, it is observed that both state and private capital exist mainly in the sectors of industry, commerce and construction. According to the data on capital ownership in industrial sectors by province from The Third National Industrial Census of China in 1995, I calculate the proportions of private capital in total capital,

and apply them to the data in 1992 to get the amounts of private capital in industrial sectors in 1992. Since the data on capital ownership in commerce and construction sectors are unavailable, I assume that the proportions of private capital in total capital are the same as in the industrial sector. The capital income in these sectors is distributed between the state and private holders. The sectors of public service, education and culture, finance and banking, and administration are dominated by state capital. Capital income in these sectors is collected by the government only.

7.3.2 The income of social classes

Capital holders earn rents. But, there is a small group of people who have capital, and only a few of them hold a significant amount of capital and rely on the capital income. For this reason, this research simply assumes that the people who own significant amounts of capital are capitalists, and that the capitalist is the sole earner of private capital income. The capitalist's income is separated from total capital income, which includes both government and private capital incomes, according to the proportions of private capital in total capital in the sector. Denote

α – the share of private capital income in total capital income,

I – capitalists' average income,

N – the number of capitalists,

then

$$I^j = \frac{\alpha^j I K_b^j}{N^j}.$$

This research considers that, in competitive markets, self-employed capital is necessary for operating the business. Thus, it will not yield extra rent than the business income that is the same as the wage of the skilled (since self-employed labor was assumed to belong to skilled labor). Therefore, self-employed income is set by the skilled wage. Because retirees consist of various types of labor and also capitalists, the income in this class is considered to be equal to the mean income that is the average of the income of the technician, the manager, the skilled and self-employed, the unskilled, and the capitalist. Because dependants share income with those they depend on within the family, their income is therefore the mean income divided by the dependency ratios. Although in competitive markets the same type of labor earn the same income (no matter whether the labor is in the rural area or in an urban area), the mean incomes are different between rural and urban areas owing to the difference

in population compositions and in dependency ratios between the areas. Therefore, after the transfer and family income distribution, income with respect to each social class will be different in rural and urban areas.

The final results of income levels regarding all social classes are presented in Table 7.9. Based on the population in Table 7.4 and the income in Table 7.9, the inequality of personal income distribution in the competitive markets is measured by calculating Theil's index. The results are presented in Table 7.10.

7.4 Income inequality under perfect competition

7.4.1 The overall inequality

Under perfect competition, income inequality will be great in China. Table 7.9 shows that in rural areas, the highest income (or the rural capitalist's income, which increases to over ten times as much as in the current markets), will be 451 times higher than the lowest income, the rural unskilled income, which decreases nearly 65% from the current markets. In urban areas, the figure will be 488 times. With respect to each social class, just as in the current markets, the income in urban areas will be higher than in rural areas in the competitive markets. In the current markets, the urban mean income is two times that of the rural mean income. But, in the competitive markets, the urban mean income will be almost five times higher than the rural mean income. Among the provinces, Beijing will have the highest income, while Guizhou will have the lowest. The former will be about 20 times higher than the latter.

Table 7.10 gives precise and comprehensive information on income differences in the form of Theil's index. According to Theil's index, the overall inequality in China is 0.6467 in row 33 and column 5; this consists of the inequality between social classes, which is 0.4664, in row 31 and column 3; the inequality between provinces, which is 0.0718, in row 32 and column 3; and the inequality between rural and urban areas, which is 0.1085, in row 31 and column 4. The inequality between social classes contributes about 72% to the overall inequality, the inequality between rural and urban areas 17%, and the inequality between provinces 11%.

Compared with the current markets, in the competitive markets the overall inequality will increase six and a half times, the inequality between social classes over 17 times, the inequality between provinces three and a half times, and the inequality between rural and urban areas nearly four times.

Table 7.9 **Income in Competitive Chinese Economy**

The Eastern Part

		China	BJ	SH	TJ	JS	LN	GD	ZJ	FJ	SD	HB
1	Rural unskilled	218	160	250	197	234	207	193	212	181	214	198
2	Rural skilled	942	160	250	197	234	207	691	2053	2760	2896	2128
3	Rural manager	12353	160	8263	11638	20584	207	691	2053	16944	22521	21052
4	Rural technician	21328	25499	41628	31376	40134	35331	53994	35247	16944	22521	21052
5	Rural self-employed	1039	160	250	197	234	207	691	2053	2760	2896	2128
6	Rural capitalist	98375	43017	909450	66119	243337	59832	107133	46978	37872	76011	71207
7	Rural retiree	2705	7137	6472	3221	5251	2187	2325	2387	2079	1315	1241
8	Rural dependant	895	3201	4526	1780	3432	1264	1250	1412	1055	783	686
	Rural mean income	820	3267	4539	1724	3411	1192	1190	1348	1006	692	610
1	Urban unskilled	233	245	249	225	282	217	208	225	196	227	225
2	Urban skilled	1204	245	249	225	282	217	743	2182	2988	3080	2422
3	Urban manager	11610	245	8206	13248	24798	217	743	2182	18341	23947	23965
4	Urban technician	26525	38947	41339	35718	48350	37044	58051	37464	18341	23947	23965
5	Urban self-employed	1442	245	249	225	282	217	743	2182	2988	3080	2422
6	Urban capitalist	113906	65705	903135	75267	293154	62733	115183	49932	40993	80822	81059
7	Urban retiree	4650	19128	12416	9444	4789	4568	4713	2755	2094	1978	1855
8	Urban dependant	1889	13102	8622	5940	3771	2769	2725	1733	1151	1252	1167
	Urban mean income	3745	12215	10840	6865	8809	4131	5035	3803	3277	2985	3586
	Overall mean income	1618	10361	8706	5271	5022	2659	2589	2118	1471	1345	1211

Table 7.9 (continued) **Income in Competitive Chinese Economy**

The Middle Part

		AH	HLJ	SX	JL	NM	HuN	HuB	JX	HeN
1	Rural unskilled	175	186	165	197	578	208	212	199	212
2	Rural skilled	1227	186	863	538	688	762	693	1333	2215
3	Rural manager	1227	17536	9814	13585	921	20384	5082	13977	2215
4	Rural technician	11300	17536	12012	13585	921	20384	15743	13977	15125
5	Rural self-employed	1227	186	863	538	2753	762	693	1333	2215
6	Rural capitalist	195901	84195	15139	86308	6881	62167	125856	28783	123538
7	Rural retiree	6875	1768	2042	1193	2403	1149	940	1174	956
8	Rural dependant	3354	921	945	655	672	668	556	652	565
	Rural mean income	3466	864	912	584	670	586	469	581	477
1	Urban unskilled	321	184	219	189	814	212	213	199	211
2	Urban skilled	2246	184	1144	518	1394	776	698	1333	2202
3	Urban manager	2246	17266	13005	13081	1443	20746	5113	13977	2202
4	Urban technician	20683	17266	15918	13081	1466	20746	15836	13977	15036
5	Urban self-employed	2246	184	1144	518	5564	776	698	1333	2202
6	Urban capitalist	358570	82899	20062	83111	13910	63271	126605	28783	122812
7	Urban retiree	4953	3652	2884	2443	2403	1211	1275	1102	784
8	Urban dependant	4422	1873	1770	1292	1195	716	759	612	461
	Urban mean income	5333	2855	3127	2199	1406	2581	1825	1900	1958
	Overall mean income	4424	1782	1662	1242	937	935	848	843	696

Table 7.9 (continued) **Income in Competitive Chinese Economy**

The Western Part

		GS	XJ	NX	YN	HN	QH	TB	ShX	SC	GX	GZ
1	Rural unskilled	114	82	64	115	725	202	714	200	231	197	204
2	Rural skilled	661	328	296	528	863	202	850	200	231	2159	1407
3	Rural manager	661	328	296	528	1155	17807	1137	18327	23470	16880	12645
4	Rural technician	10537	10538	7551	4574	1155	17807	1137	18327	23470	16880	12645
5	Rural self-employed	661	328	296	528	3453	202	3400	200	231	2159	1407
6	Rural capitalist	11680	13173	8742	17939	8632	11281	8499	24646	134827	38235	14880
7	Rural retiree	12432	11977	13052	5174	2279	1658	3956	1140	951	994	720
8	Rural dependant	3985	2760	2323	1658	843	936	830	637	614	549	411
	Rural mean income	4154	3080	2455	1794	862	862	820	561	505	473	327
1	Urban unskilled	310	225	250	306	1382	186	1734	208	224	198	192
2	Urban skilled	1794	895	1163	1407	2367	186	2969	208	224	2171	1324
3	Urban manager	1794	895	1163	1407	2450	16416	3072	19073	22737	16974	11897
4	Urban technician	28587	28765	29675	12198	2490	16416	3123	19073	22737	16974	11897
5	Urban self-employed	1794	895	1163	1407	9467	186	11894	208	224	2171	1324
6	Urban capitalist	31690	35957	34358	47838	23667	10400	29735	25649	130614	38447	14000
7	Urban retiree	8275	10446	10800	3552	2279	1733	3956	1531	1024	1147	765
8	Urban dependant	7196	6570	7553	3036	2042	903	2159	890	640	637	411
	Urban mean income	7009	7016	7596	3572	2650	2335	3398	2655	2258	2590	1374
	Overall mean income	5882	5056	4920	2565	1290	1228	1117	997	845	784	523

Table 7.10 **Income Inequality in the Competitive Economy**

		Rural inequality	Urban inequality	Across area	Between area	Provincial inequality	Across area	Between area	Mean income	Per capita final uses
		1	2	3	4	5	6	7	8	9
Beijing	1	0.3506	0.29	0.2939	0.0339	0.3279	90%	10%	10361	10772
Fujian	2	0.3324	0.3584	0.344	0.0633	0.4072	84%	16%	1471	2430
Tianjin	3	0.5591	0.3676	0.3877	0.0521	0.4397	88%	12%	5271	5686
Zhejiang	4	0.4246	0.4807	0.4556	0.0529	0.5085	90%	10%	2118	2664
Shanghai	5	0.8358	0.4662	0.532	0.0278	0.5598	95%	5%	8706	11629
Sandong	6	0.5491	0.4125	0.4663	0.0966	0.5629	83%	17%	1345	2150
Hebei	7	0.5145	0.4002	0.4494	0.1416	0.591	76%	24%	1211	1721
Jiangsu	8	0.5664	0.5458	0.5557	0.0462	0.6019	92%	8%	5022	5719
Liaoning	9	0.6284	0.5499	0.5683	0.0647	0.633	90%	10%	2659	2995
Guangdong	10	0.6491	0.6443	0.6458	0.0994	0.7452	87%	13%	2589	3357
Neimeng *	11	0.0233	0.0461	0.0357	0.0296	0.0653	55%	45%	937	
Anhui	12	0.1877	0.2575	0.2308	0.0096	0.2404	96%	4%	4424	5283
Sanxi	13	0.3291	0.2986	0.3099	0.0751	0.3851	80%	20%	1662	3872
Jiangxi	14	0.3804	0.4273	0.4001	0.0558	0.4559	88%	12%	843	1442
Jilin	15	0.4202	0.3681	0.3838	0.075	0.4588	84%	16%	1242	2425
Henan	16	0.4125	0.4116	0.4122	0.0692	0.4813	86%	14%	696	1244
Heilongjiang	17	0.4637	0.4032	0.4198	0.0627	0.4824	87%	13%	1782	2616
Hubei	18	0.4157	0.4898	0.4574	0.0765	0.5339	86%	14%	848	1179
Hunan	19	0.4859	0.5757	0.5265	0.089	0.6155	86%	14%	935	1352

Table 7.10 (continued) **Income Inequality in the Competitive Economy**

		Rural inequality	Urban inequality	Across area	Between area	Provincial inequality	Across area	Between area	Mean income	Per capita final uses
		1	2	3	4	5	6	7	8	9
Tibet *	20	0.0181	0.1045	0.0484	0.0821	0.1305	37%	63%	1117	
Hainan *	21	0.0267	0.1082	0.0668	0.0648	0.1316	51%	49%	1290	
Yunnan	22	0.1032	0.1928	0.1573	0.0252	0.1825	86%	14%	2565	2940
Gansu	23	0.1187	0.2899	0.2421	0.0127	0.2548	95%	5%	5882	7043
Xinjiang	24	0.1358	0.2651	0.2258	0.0338	0.2596	87%	13%	5056	8580
Ningxia	25	0.0978	0.2769	0.2304	0.0612	0.2916	79%	21%	4920	5868
Guizhou	26	0.3348	0.4777	0.3975	0.0727	0.4702	85%	15%	523	963
Guangxi	27	0.4337	0.4091	0.4226	0.1137	0.5363	79%	21%	784	1384
Qinghai	28	0.4926	0.5316	0.5102	0.0426	0.5528	92%	8%	1228	2084
Shanxi	29	0.4763	0.5802	0.5308	0.105	0.6359	83%	17%	997	1650
Sichuan	30	0.5472	0.7228	0.6302	0.0861	0.7163	88%	12%	845	1280
Across provinces	31	0.4728	0.4624	0.4664	0.1085	0.5749	81%	19%		
Between provinces	32	0.08	0.0666	0.0718		0.0718	100%	0%		
Theil's inequality	33	0.5528	0.529	0.5383	0.1085	0.6467	83%	17%		
Across provinces	34	86%	87%	87%	100%	89%	72%			
Between provinces	35	14%	13%	13%	0%	11%				

7.4.2 The inequality between social classes

In particular, the greater overall inequality is mainly a result of the inequality between social classes. Table 7.9 shows that incomes of different social classes will be greatly different in both rural and urban areas and in every province. The figures in row 31 and columns 1 and 2 in Table 7.10 show that the Theil index of the income inequalities between social classes are 0.4728 in rural areas and 0.4624 in urban areas in the competitive market, which are about 15 and ten times higher than the income inequalities between social classes in the current market.

In rural areas in the competitive market, the capitalist will still earn the highest income, which is 120 times higher than the rural mean income in the competitive market, while the figure is 12 times in the current market; high-skilled people will also earn high incomes in the competitive market; the wage of the rural technician will increase about 18 times from the current market and rank at the second highest, which is 1.73 times higher than the one of rural manager, which will grow about nine times – 23 times higher than the wage of the rural skilled, and 98 times higher than the wage of the rural unskilled; the rural retiree's income will remain nearly the same as the wage in the current market, which will be 3.3 times above the rural mean income in the competitive market; from the current market, the rural self-employed income will go down 70%, skilled income will go down 13%, the dependant's income will be up 15%, and the income of all three classes will be slightly over the rural mean income in the competitive market; the rural unskilled income will go down sharply to 35% of the wage in the current market, and account for only about a quarter of the rural mean income in the competitive market.

In urban areas, the capitalist's income will increase over five times from the current to the competitive market, and will be 489 times higher than the income of the unskilled, and 30 times higher than the urban mean income in the competitive market; the technician's income will grow nearly 14 times, and will be 2.28 times higher than the manager's income, which will grow over five times – 22 times higher than the income of the skilled, and 114 times higher than that of unskilled in the competitive market; the urban retiree's income will go up 75% from the current to the competitive market, and will be slightly over the urban mean income in the competitive market; the incomes of the urban unskilled, skilled and self-employed will go down from the current to the competitive markets by 75%, 30% and 78%, respectively; the urban dependant's income will go up 32%, and the income of all four classes will drop below

the urban mean income in the competitive market.

From the current to the competitive markets, income differences among social classes will increase in every province. In Beijing, whose income will be the highest under competition, the decreasing ranking of income levels is the capitalist, the technician, the retiree, the dependant, the self-employed, the manager, the skilled and the unskilled. The capitalist's income will be 1.69 times higher than the technician's income, which is 57 times higher than the retiree's income, which is 7.97 times higher than the dependant's income. The dependant's income is 159 times higher than that of the manager, the skilled, the self-employed and the unskilled. In rural areas, the capitalist's income will be 13 times higher than the rural mean income. In urban areas, the capitalist's income will be 5.38 times higher than the urban mean income. In Sanxi, whose income is similar to the overall mean income in China, the decreasing ranking of income levels will be the capitalist, the technician, the manager, the retiree, the dependant, the self-employed and the skilled, and the unskilled. The capitalist's income will be 1.26 times higher than that of the technician. The technician's income is 1.22 times higher than the manager's income, 5.88 times higher than the retiree's income, 12.71 times higher than that of the dependant, 13.92 times higher than that of the skilled and the self-employed, and 72.8 times higher than the unskilled. In rural areas, the rural capitalist's income will be 16.6 times higher than the rural mean income. In urban areas, the urban capitalist's income will be six times higher than the urban mean income. In Guizhou, whose income is the lowest among the provinces, the decreasing ranking of income levels will be the capitalist, the technician and the manager, the skilled and the self-employed, the retiree, the dependant, and the unskilled. The capitalist's income will be 1.18 times higher than the technician's income and the manager's income, which is nine times higher than that of the skilled and the self-employed, 18 times higher than that of the retiree, 31 times higher than the dependant's income, and 62 times higher than the income of the unskilled. In rural areas, the rural capitalist's income will be 46 times higher than the rural mean income. In urban areas, the urban capitalist's income will be ten times higher than the urban mean income. The figures in columns 1, 2 and 3 from rows 1 to 30 in Table 7.10 show the inequality among social classes with respect to the rural areas, urban areas, and the average of the two areas in each province.

7.4.3 The inequality between rural and urban areas

In the competitive market, urban income will be higher than rural income. Table 7.9 shows that the urban mean income is 4.57 times higher than the rural mean income. In every province, the urban income will be higher than the rural income. With respect to each social class, the income in urban areas will also be higher than in rural areas. In each province, there are three factors determining the income of either area: the income of the capitalist and labor, population composition and the dependency ratio. In the competitive market, labor is freely mobile between rural and urban areas. Wages will be determined only by the productivity of labor, no matter where the work is – in rural or urban areas. In other words, there is no difference in income between the same types of rural and urban labor. In the empirical section, rural and urban private capital is not distinguished; in other words, rural and urban capitalists are considered to have the same capital income. Therefore, the remaining factors are only the population composition and the dependency ratio. Because low-skilled labor holds relatively more shares in rural areas than in urban areas, and high-skilled labor holds relatively fewer shares in rural areas than in urban areas, the mean of rural labor's income and the capitalist's income (which is weighted by labor and the capitalists), is lower than the mean of urban labor's income and the capitalist's income. As the empirics assume that the retiree's income equals the mean, the rural retiree has a lower income than the urban retiree. Also, owing to the fact that there are more dependants in rural areas than in urban areas in China, the income of rural labor and that of the capitalist will be discounted more than the income of their urban counterpart, after the income is shared with dependants. Because the dependant's income is the mean of labor and capitalist income, divided by the dependency ratio, the income is affected by both the population composition and the dependency ratio. Therefore, the income of the rural dependant is much lower than that of an urban dependant.

The income inequality between areas in the nation, which contributes 14% of the overall inequality, is the figure in row 33 and column 4 in Table 7.10. The other figures regarding the inequality between areas by province are listed in column 4 in Table 7.10. In all provinces, except for the three provinces that did not participate the competition, the inequality between areas holds a proportion of around ten percent in the provincial inequality.

From the current to the competitive market, the income gaps in most provinces

between rural and urban areas will be extended. By comparing the results in Tables 4.3 and 7.10, it can be found that the Theil index of the overall income inequality between rural and urban areas will go up nearly four times. In the developed eastern part, the income inequalities between rural and urban areas will go up in all the provinces. In the less-developed middle part, the income inequalities between rural and urban areas will also go up in all the provinces except for Anhui province (whose farmers migrate in great numbers). In the under-developed western part, the income inequalities between rural and urban areas will go up in six of the 11 provinces, and will go down in the remaining five provinces (whose farmers migrate in great number.

7.4.4 The inequality in rural and urban areas

The inequality in either rural or urban areas can be divided into the inequality between social classes and the inequality between provinces. In the competitive market, the inequality between social classes will contribute the most to the area's inequality. The figure in row 33 and column 1 in Table 7.10 is the rural inequality, according to which the overall inequality in rural areas will be made up of the inequality between social classes in rural areas (86%), and of the inequality between provinces in rural areas (14%). The figure in row 33 and column 2 in Table 7.10 is the urban inequality, which will be made up of the inequality between social classes in rural areas (87%) and of the inequality between provinces in rural areas (13%).

Chapter 4 shows that in the current market the overall inequality in rural areas is slightly less than in urban areas in the nation, in all under- or less-developed provinces (except for Sanxi province), and in four of the ten developed provinces. In the competitive market, the figures in columns 1 and 2 in Table 7.10 show that the overall inequality in rural areas will be greater than in urban areas in the nation, in eight of the ten developed provinces in the eastern part, in four of the nine less-developed provinces in the middle part, and in one of the 11 under-developed provinces in the western part. But, in the other 17 provinces there will be opposite situations.

Just as in the current market, the inequality between provinces in rural areas will be larger than the inequality between provinces in urban areas in the competitive market. The richest rural areas are concentrated in the provinces in the eastern part. According to Table 7.9, eight of the ten provinces in the eastern part have incomes above the rural mean income; in the middle part, three of the nine provinces are above the mean; and in the western part, seven of the 11 provinces are above the mean. The

richest urban areas are concentrated in the eastern part, while the poorest urban parts are found in the middle and the western parts. According to Table 7.9, seven of the ten provinces in the eastern part have income above the urban mean income; in the middle part, one of the nine provinces are above the mean; and in the western part, three of the 11 provinces are above the mean.

7.4.5 The inequality in provinces

The inequality in provinces can be decomposed into two parts: the inequality between social classes and between rural and urban areas. Just as in the current market, in the competitive market in all the provinces that participate the competition, the inequality between social classes will contribute most to the overall provincial inequality. Theil's index inequalities in provinces are listed in column 5 from rows 1-30. From the current to the competitive market, the overall inequalities will increase in all the competitive provinces. In each province, around 85% of the Theil's index inequality will be contributed by the inequality between social classes, which is listed in column 3, and only a small part will be contributed by the inequality between rural and urban areas in each province. In the eastern part, Guangdong will have the biggest inequality, and Beijing the smallest inequality; in the middle part, Hunan will have the biggest inequality, and Anhui the smallest inequality (except for Neimeng, which does not participate in the competition); in the western part, Sichuan will have the biggest inequality, and Yunnan the smallest (except for Tibet and Hainan, which do not participate in the competition).

In the current market, because of the significant existence of the income inequality between rural and urban areas, the income inequality in each province is negatively related to economic development. Under perfect competition, the income inequality in each province will not be related to development in the province – neither will the inequality between social classes nor the inequality between areas. Table 7.10 lists the data for each part of the country, listed increasingly according to the inequality in each province to show that there is no significant relationship between the income inequalities that exist and the development of the province.

7.4.6 The inequality between provinces

From the current to the competitive market, income inequality between provinces will grow 2.5 times. In the competitive market, the income inequality between provinces

is 0.0718 (in row 32 and column 5 in Table 7.10), which contributes 11% to the overall inequality in China. According to Table 7.9, Beijing, in the eastern part, will have the highest income, which is over eight times higher than the lowest income in Hebei; in the middle part, Anhui will have the highest income, which is over six times higher than the lowest income in Henan; in the eastern part, Gansu will have the highest income, which is over 11 times higher than the lowest income in Guizhou. By comparing the incomes among the three parts, the income in Beijing will be over two times higher than the income in Anhui and less than two times higher than the income in Gansu; the income in Hebei will be nearly two times higher than the income in Henan and over two times higher than the income in Guizhou. The overall mean income in the nation will be 1618. Provinces with incomes above the mean are as follows: seven of the ten provinces in the eastern part, three of the nine provinces in the middle part, and four of the 11 provinces in the western part. Apparently, the eastern part will be the richest, the middle and the western parts will be the poorest, and the income difference between the two parts will be relatively small.

7.5 Conclusion

The inequalities in China and the provinces will become much higher under perfect competition. The inequality in China overall is shown to grow six times greater. Among the three decomposed inequalities, the inequality between social classes will contribute the most to the overall inequality, the inequality between provinces the second most, and the inequality between rural and urban areas the least. In each province, the inequality between social classes will also increase.

As in the observed market, in the competitive market the overall inequality in rural areas will be also slightly less than in urban areas, and the overall inequality between social classes in rural areas will be also lower than in urban areas. In particular, only in some developed provinces will the inequality between social classes in rural areas be higher than in urban areas.

The inequality between rural and urban areas will increase, but its share in the overall inequality will decrease. This is because the competitive markets allow labor to move freely between rural and urban areas; the rural and urban areas are no longer the factor causing the difference in labor's income. The remaining inequality between rural and urban areas results from the difference in composition and the dependency

ratio of the population between rural and urban areas.

Income inequality will not be related to economic development. In the competitive market, the majority of the inequality will arise from the inequality between social classes, which is irrelevant to development. It was observed that the inequality between rural and urban areas was related to economic development. But, in the competitive market, the share of the inequality between rural and urban areas in the overall inequality will decrease.

The inequality between provinces will increase, but its share in overall inequality will decrease. The increase in the inequality between provinces is caused by the expansion of capital income and wages of highly ranked labor between provinces in the competitive market. The decrease in the share in overall inequality results from the great increase of the inequality between social classes.

Chapter 8

Conclusion

This research attempted to explore what effect a market economy would have on the distribution of personal income in China. To serve this purpose, I developed a theory of the distribution of economic determinants of income by constructing a computable general equilibrium model to outline the perfectly competitive economy and, in particular, the income distribution. I then conducted an experiment based on the real economy in China. Throughout the research, I have reviewed the advanced theories on income distribution, the Chinese economy, the modelling process, and the personal income distributions in the actual current market economy as well as in a hypothetical one. This chapter offers some conclusions to this research. I shall summarize the results from three angles: What is the current distribution of personal income in the Chinese marketplace, and what is it in the hypothetical competitive market? How will the distribution of income change as the current economy evolves toward that of the hypothetical competitive marketplace? Which regions, areas and social classes will be the winners and losers of competition? In addition to answering these questions I shall also evaluate my model and the empirical results. With respect to the modelling, first the achievements of the research will be mentioned; the discussion subsequently moves on to the limits. Some of the limits have potential for improvement. With regard to the empirics, although the utmost has been done to collect sound data, some rough estimations and assumptions on the non-existing data may still hurt the results considerably.

8.1 On personal income distribution

Income inequality is low in the current Chinese market, but it will increase greatly under perfect competition. In particular, among the income inequalities, the inequality between social classes will increase the most, and will contribute to the majority of the overall inequality.

Research has concluded that compared to other developing countries in Asia, China's overall income inequality is low. The Gini coefficients calculated in 1988 by Griffin, Lee, Karn and Zhao (1994) was 0.382. Wang et al. (1995) found out that Gini coefficients in 1993 were 0.331 for rural areas and 0.242 for urban areas. The Theil's index that I calculated in Chapter 4 followed their results. In 1992, the Theil's inequality was less than 0.09 for China as a whole, and about 0.06 for both rural and urban areas. The low inequality in the current Chinese market reflects the fact that the income differences between social classes, between regions and between rural and urban areas are relatively small in the current market. Among the overall Theil's inequality, the inequality between social classes is less than 0.04, the inequality between rural and urban areas is about 0.03, and the inequality between provinces is a little over 0.02.

According to the Theil's index that I calculated in Chapter 7 for the competitive market, this situation changed dramatically. Table 8.1 shows that the overall inequality increased about seven times – from 0.09 in the observed market to 0.65 in the competitive market, among which the inequality between social classes increased about 12 times, from 0.04 to 0.47, the inequality between areas increased nearly four times, from 0.03 to 0.11, and the inequality between provinces increased three and a half times, from 0.02 to 0.07.

The biggest increase is the inequality between social classes. In competitive markets, highly skilled labor and capitalists will be the big winners and retirees and dependants will be modest winners; the unskilled, the self-employed and skilled workers will be the losers. Column 1 in Table 8.2 shows that in rural areas, the technician's income increases nearly 20 times, the manager's ten times, a capitalist's ten times, a retiree's one time, a dependant's a little over one times; a skilled worker's income, however, decreases to 0.87 times, the self-employed to 0.3 times, and an unskilled worker to 0.34 times. In urban areas, the technician's income increases nearly 15 times, the manager's six times, a capitalist's six times, a retiree's less than two times, and a dependant's over one times; the income of the skilled, however, will decrease to

Table 8.1 **Inequality Changes in the Competitive Economy (ratios)**

		Rural inequality	Urban inequality	Across areas	Between areas	Provincial inequality	Per capita final uses
		1	2	3	4	5	6
Shanghai	1	25.88	22.31	22.26	4.48	18.6	1.02
Tianjin	2	10.73	14.36	12.08	13.36	12.25	1.16
Beijing	3	6.34	8.84	7.9	5.84	7.63	1.62
Sandong	4	11.35	9.27	9.88	60.38	11.53	0.55
Jiangshu	5	19.27	18.38	18.84	2.09	11.69	1.73
Zhejiang	6	7.65	9.33	8.39	105.8	9.28	0.74
Liaoning	7	18.87	13.71	15.03	3.46	11.2	0.83
Guangdong	8	16.56	9.73	12.61	18.41	13.17	0.75
Fujian	9	13.57	3.96	7.3	3.35	6.17	0.58
Hebei	10	11.21	12.24	10.93	4.14	7.85	0.65
Heilongjiang	11	29.54	9.25	13	5.5	11.04	0.67
Hubei	12	16.5	13.8	15.4	3.51	10.35	0.62
Jianxi	13	13.59	7.3	10.61	3.49	8.49	0.54
Jilin	14	22.84	8.09	11.19	3.19	7.94	0.52
Hunan	15	18.91	11.01	15.22	3	9.57	0.61
Neimeng	16	1	1	1	1	1	
Henan	17	17.93	9.05	13.6	1.74	6.87	0.5
Anhui	18	7.03	4.44	6.09	0.25	3.12	3.71
Sanxi	19	7.64	9.16	8.18	1.78	4.81	0.61
Guizhou	20	20.05	7.61	12.31	2.81	8.08	0.49
Shichuan	21	19.83	15.48	18.37	3.35	11.94	0.57
Guangxi	22	18.77	6	11.39	3.13	7.32	0.51
Yunnan	23	4.14	4.3	4.98	0.52	2.27	3.97
Shanxi	24	17.32	14.76	16.18	1.79	6.94	0.58
Xinjiang	25	4.18	5.34	5.33	0.56	2.53	1.36
Ningxia	26	4.08	7.44	7.38	0.79	2.7	2.25
Gansu	27	4.53	7.12	7.25	0.16	2.24	3.88
Tibet	28	1	1	1	1	1	
Hainan	29	1	1	1	1	1	
Qinghai	30	21.23	11.53	13.98	0.44	4.12	0.54
Across provinces	31	14.59	10.16	12.27	3.82	8.65	
Between provinces	32	3.29	4.09	3.45		3.45	
Theil's inequality	33	9.75	8.56	9.14	3.82	7.41	

Table 8.2 **Income Changes in Competitive Chinese Economy (ratios)**

			The Eastern Part								
		China	Beijing	Shanghai	Tianjin	Jiangsu	Liaoning	Guangdong	Zhejiang	Fujian	Sandong	Hebei
1	Rural unskilled	0.34	0.12	0.13	0.17	0.26	0.24	0.17	0.18	0.21	0.31	0.34
2	Rural skilled	0.87	0.1	0.11	0.15	0.22	0.2	0.52	1.47	2.74	3.52	3.05
3	Rural manager	10.32	0.07	2.71	6.49	14.16	0.15	0.39	1.1	12.57	20.47	22.54
4	Rural technician	19.21	11.84	13.65	17.5	27.6	25.92	30.13	18.93	12.57	20.47	22.54
5	Rural self-employed	0.3	0.02	0.03	0.04	0.05	0.05	0.13	0.37	0.68	0.88	0.76
6	Rural capitalist	10.06	2.67	39.9	4.93	22.4	5.87	8	3.38	3.76	9.24	10.2
7	Rural retiree	1.05	2.28	1.89	1.14	1.97	0.82	0.75	0.84	0.87	0.5	0.43
8	Rural dependant	1.15	2.04	2.03	1.36	3.23	1.27	0.96	1.04	1.07	0.98	1.01
	Rural mean income	1.03	1.79	1.87	1.21	3.13	1.16	0.87	0.88	1.01	0.81	0.85
1	Urban unskilled	0.25	0.16	0.12	0.2	0.22	0.2	0.19	0.28	0.19	0.34	0.22
2	Urban skilled	0.69	0.09	0.07	0.12	0.13	0.12	0.4	1.59	1.7	2.68	1.36
3	Urban manager	6.38	0.09	2.24	6.64	10.85	0.11	0.39	1.54	10.06	20.11	13.02
4	Urban technician	14.52	13.84	11.09	17.62	20.81	19.19	29.72	25.96	9.89	19.77	12.82
5	Urban self-employed	0.22	0.02	0.02	0.03	0.03	0.03	0.1	0.4	0.42	0.67	0.34
6	Urban capitalist	6.17	2.45	25.49	3.9	13.28	3.43	6.21	3.64	2.33	7.03	4.56
7	Urban retiree	1.75	6.12	3.63	3.35	1.8	1.71	1.52	0.96	0.87	0.75	0.64
8	Urban dependant	1.32	5.32	2.56	3.34	1.89	1.71	1.74	1.49	0.77	1.37	0.76
	Urban mean income	2.22	4.49	3.06	3.55	4.04	2.2	2.66	2.77	1.72	2.9	2.09
	Overall mean income	1.57	4.17	2.75	2.96	3.79	1.82	1.66	1.43	1.23	1.49	1.33

Table 8.2 (continued) **Income Changes in Competitive Chinese Economy (ratios)**

		The Middle Part								
		Anhui	Heilongjiang	Sanxi	Jilin	Neimeng	Hunan	Hubei	Jiangxi	Henan
1	Rural unskilled	0.35	0.23	0.31	0.28	1	0.33	0.36	0.3	0.42
2	Rural skilled	2.09	0.19	1.34	0.65	1	1.01	1	1.7	3.68
3	Rural manager	1.56	13.49	11.42	12.28	1	20.14	5.47	13.29	2.75
4	Rural technician	14.38	13.49	13.98	12.28	1	20.14	16.95	13.29	18.77
5	Rural self-employed	0.52	0.05	0.34	0.16	1	0.25	0.25	0.42	0.92
6	Rural capitalist	33.33	8.66	2.36	10.44	1	8.22	18.13	3.66	20.52
7	Rural retiree	3	0.72	0.78	0.5	1	0.48	0.43	0.55	0.39
8	Rural dependant	5.84	0.97	1.51	0.81	1	0.9	0.82	0.85	0.96
	Rural mean income	6.09	0.92	1.37	0.74	1	0.8	0.7	0.75	0.83
1	Urban unskilled	0.38	0.22	0.23	0.22	1	0.21	0.27	0.24	0.23
2	Urban skilled	1.57	0.13	0.69	0.35	1	0.46	0.52	0.94	1.4
3	Urban manager	1.51	11.45	7.61	8.56	1	11.81	3.67	9.56	1.35
4	Urban technician	13.71	11.27	9.16	8.41	1	11.63	11.17	9.41	9.06
5	Urban self-employed	0.39	0.03	0.17	0.09	1	0.11	0.13	0.24	0.35
6	Urban capitalist	24.99	5.7	1.22	5.63	1	3.73	9.4	2.03	7.78
7	Urban retiree	2.16	1.48	1.11	1.02	1	0.51	0.59	0.52	0.32
8	Urban dependant	3.75	1.49	1.21	1	1	0.51	0.66	0.53	0.35
	Urban mean income	3.66	1.92	1.92	1.43	1	1.53	1.41	1.33	1.27
	Overall mean income	6.09	1.48	1.76	1.12	1	1.03	1	0.93	0.96

Table 8.2 (continued) **Income Changes in Competitive Chinese Economy (ratios)**

		The Western Part										
		Gansu	Xinjiang	Ninxia	Yunnan	Hainan	Qinhai	Tibet	Shanxi	Sichuan	Guangxi	Guizhou
1	Rural unskilled	0.27	0.13	0.13	0.22	1	0.39	1	0.42	0.42	0.31	0.47
2	Rural skilled	1.32	0.43	0.49	0.83	1	0.33	1	0.35	0.36	2.88	2.72
3	Rural manager	0.99	0.32	0.37	0.62	1	21.56	1	23.93	27.01	16.83	18.25
4	Rural technician	15.73	10.39	9.32	5.4	1	21.56	1	23.93	27.01	16.83	18.25
5	Rural self-employed	0.33	0.11	0.12	0.21	1	0.08	1	0.09	0.09	0.72	0.68
6	Rural capitalist	2.33	1.74	1.44	2.83	1	1.83	1	4.31	20.77	5.1	2.87
7	Rural retiree	4.28	4.34	4.76	1.83	1	0.47	1	0.47	0.41	0.39	0.3
8	Rural dependant	8.15	3.73	3.93	2.68	1	1.55	1	1.14	0.97	0.75	0.81
	Rural mean income	8.64	4.04	4.18	2.94	1	1.44	1	1	0.81	0.65	0.67
1	Urban unskilled	0.3	0.18	0.22	0.28	1	0.14	1	0.21	0.27	0.19	0.3
2	Urban skilled	1.02	0.42	0.59	0.75	1	0.08	1	0.13	0.16	1.22	1.2
3	Urban manager	0.99	0.4	0.57	0.73	1	7.12	1	11.08	15.63	9.23	10.45
4	Urban technician	15.47	12.75	14.41	6.21	1	7.01	1	10.9	15.38	9.08	10.28
5	Urban self-employed	0.26	0.1	0.15	0.19	1	0.02	1	0.03	0.04	0.3	0.3
6	Urban capitalist	1.8	1.68	1.75	2.56	1	0.47	1	1.54	9.29	2.16	1.27
7	Urban retiree	2.85	3.78	3.94	1.26	1	0.49	1	0.63	0.45	0.46	0.32
8	Urban dependant	4.84	3.59	4.3	1.98	1	0.46	1	0.62	0.56	0.44	0.48
	Urban mean income	4.15	3.19	3.85	1.99	1	1	1	1.6	1.7	1.39	1.31
	Overall mean income	7.88	4.11	5.2	3.26	1	1.17	1	1.25	1.1	0.88	0.88

seventy percent, that of the self-employed to twenty percent, and that of the unskilled to twenty-five percent. In most of the provinces, the technicians will be the biggest winners, and the unskilled and the self-employed will be the biggest losers. In Shanghai (in the eastern part), and Anhui, Hubei, and Henan (in the middle part), capitalists will be the biggest winners. But, in Qinhai (in the western part), the urban capitalist will lose.

There exists a notable difference in income between rural and urban areas in the current Chinese market. This problem will become more serious in the competitive market. However, the share of the income inequality between the areas in the overall measure of inequality will go down.

Chapter 4 stated that there existed an obvious distinction between rural and urban economies. In the actual current economy, income differences between rural and urban areas is observed by most research. Wang et al. (1995) pointed out that urban income was 2.33 times rural income in 1992, 2.54 times rural income in 1993, and 2.61 times rural income in 1994. In Chapter 4, I calculated that urban income was over two times higher than rural income in China, and also observed that in all other provinces (except for Zhejiang where rural income was higher than urban income), urban incomes were higher than rural incomes. The overall Theil inequality between rural and urban areas that I calculated is 0.028 for the nation.

Under perfect competition, the inequality between rural and urban areas will increase to 0.11, and rank at the second biggest growth behind the growth of the inequality between social classes. This is because the growth rate of urban income is faster than that of rural income. In the competitive market, urban areas will be the winners in all provinces, and rural areas will be the relatively small winners in nine provinces, the big winners in six provinces, and the losers in 12 provinces. Column 1 in Table 8.2 shows that urban mean income will increase over two times, whereas rural mean income will increase just one time. In nine of the 27 provinces that participate in the competition, both rural and urban areas are the winners, but because the growth rate of urban income is higher than that of rural income, urban areas will be the big winners. However, in Anhui (in the middle part), and in Gansu, Xinjiang, Ningxia, Yunnan and Qinghai, opposite situation occurs in which rural areas are the big winners. Moreover, when urban areas are the winners across all provinces, rural areas will be the losers in 12 other provinces (in Guangdong, Zhejiang, Sandong and Hebei in the eastern part, in Heilongjiang, Jilin, Hunan, Hubei, Jiangxi and Henan in the middle part, and in Sichuan, Guangxi and Guizhou in the western part).

In the competitive market, the share of inequality between rural and urban areas in the overall inequality decreases relatively, as its level increases by a factor 3.82 only, whereas the inequality across areas goes up by a factor 9.14 (Table 8.2, bottom line). By comparing the figures in column 7 in Tables 4.3 and 7.10, one can see the decrease in share in most of the provinces (except for the four developed provinces, Tianjin, Sandong, Zhejiang and Guangdong, as the levels in the provinces increases by factors 13.36, 60.38, 105.8 and 18.41, whereas the inequalities across areas go up by factors 12.08, 9.88, 8.39 and 12.61, respectively (Table 7.10, cells on column 7 and rows 2, 4, 6 and 8).), which means that in the other 23 provinces the growth rate of the inequality between social classes is higher than the growth rate of the inequality between rural and urban areas – but that in the four developed provinces the opposite is true.

Inequalities in rural and urban areas are about the same in China. Within the areas, inequality differs by stage of development. In lesser- and under-developed provinces, inequality is mostly in urban areas, whereas in the developed provinces inequality is mostly in rural areas. All these findings will remain valid under perfect competition.

While most of the Asian developing countries report less inequality in rural areas than in urban areas,[1] some research has also observed that rural areas have more inequality than urban area in China. Griffin et al. (1994) calculated the Gini coefficients for China in 1988 as 0.334 in rural areas and 0.233 in urban areas. Wang et al. (1995) calculated the Gini coefficients for China in 1993 as 0.331 in rural areas, and 0.242 in urban areas. Both concluded that rural inequality was higher than urban inequality.

Is it really true that China is different from the other developing economies in Asia? My calculation of Theil's index gave a negative answer to the question. The results in Chapter 4 revealed that, just as in other developing countries in Asia, the inequality in rural areas in China was nearly same as the inequality in urban areas. In Table 4.3, the inequality in rural areas is 0.0567 (in row 33 and column 1), and the inequality in urban areas is 0.0618 (in row 33 and column 2). My conclusion differed from the others in that the inequality in rural areas was found to be slightly less than the inequality in urban areas. Griffin et al. (1994) and Zhu (1990) concluded that the inequality in rural areas was usually greater than in urban areas in all provinces. This research distinguishes China's provinces into developed, less-developed and under-developed

[1] See, Griffin et al. (1994).

in Chapter 4. Through my calculation, I found that the inequality in rural areas was larger than the inequality in urban areas in only six of ten developed provinces; the inequality in rural areas was less than the inequality in urban areas in the remaining 22 less- and under-developed provinces.

The results in Chapter 7 revealed that the competitive market would have a similar situation, as the bottom line of Table 8.1 shows that rural and urban inequalities are affected by roughly equal factors, 9.75 and 8.56, respectively. A careful check with respect to provinces shows that in eight of the ten provinces in the eastern part, in four of the nine provinces in the middle part, and one of the 11 provinces in the western part, the rural inequalities will be larger than the urban inequalities; in other 17 provinces, however, most of which are the less- and least-developed provinces, urban areas will have more inequalities than rural areas. This phenomena may be understood by reasoning that in developed provinces there are relatively larger proportions of high-income people in rural areas, whereas in under-developed provinces, there are relatively larger proportions of low-income people in rural areas.

Income inequality between provinces contributes significantly to the overall inequality, to the inequality in rural areas, and to the inequality in urban areas. This inequality will increase under perfect competition, but its shares in the overall inequality, in the inequality in rural areas, and in the inequality in urban areas will decline.

In a big country like China, income differences certainly exist between regions. Griffin et al. (1994) compared the income in rural areas among all provinces, and the income in urban areas among ten provinces in 1988. They were unable to justify the inequalities between the provinces in either rural or urban areas. Wang et al. (1995) compared the income levels in rural areas between the eastern, the middle and the western parts, and found out that the ratio was 2.58 : 1.16 : 1 in 1992. Further, they compared income levels in rural areas between provinces for each of the three parts. They concluded that there was big difference in income between the eastern part and the middle and western parts, a small difference in income between the middle and the western parts, a big difference in income between the provinces within the eastern part, and small difference in income between the provinces within the middle and the western parts. With respect to the difference in urban income between regions, they found out that the ratio of income in the three parts was 2.13 : 0.89 : 1, and made a similar conclusion as they did for rural income. Their analysis was rather rough, because they used the income of a special province in each part to represent

the income of the part. Yang (1992) calculated the relative mean deviation of per capita GNP in 1989 with respect to the eastern, the middle and the western part, and the provinces in the parts. He got a similar conclusion as Wang et al. (1995). Wei (1992) calculated the weighted relative mean deviation of per capita national income, and also obtained a similar result. All these research attempts were unable to come up with some answers about the income inequality between provinces in China.

To begin with, the results that I obtained in Chapter 4 can directly draw the conclusions that are similar to the others above. Table 4.2 shows that the eastern part is richer than the middle and the western parts, and that the middle and the western parts are close. Evidently, eight of ten provinces in the eastern part, two of nine provinces in the middle part, and four of 11 provinces in the western part that have income above the mean income in the nation. In the eastern part, there is big difference in income, because the highest income in Shanghai is over three and a half times higher than the lowest income in Sandong; in the middle part, the income difference is not that big, because the highest income in Heilongjiang is nearly two times higher than the lowest income in that part – in Henan; in the western part, the income difference is also small, because the highest income in Hainan is over two times higher than the lowest income in Guizhou. In addition to these results, however, Chapter 4 provided deeper results regarding the inequality between provinces in the form of Theil's index.

In the current Chinese market, the inequality between provinces contributes significantly to the overall income inequality. According to the data in Table 4.3, the inequality between provinces in rural areas accounts for 43% of the overall inequality in rural areas; the inequality between provinces in urban areas accounts for 26% of the overall inequality in urban areas; and, the inequality between provinces accounts for 33% of the overall inequality in China.

Under perfect competition, the inequality between provinces will increase, but its share in the overall income inequality will decrease. According to Table 7.10, the inequality between provinces in rural areas will increase over three times, but it is only 14% of the inequality in rural areas; the inequality between provinces in urban areas will increase slightly over four times, but it is only 13% of the inequality in urban areas; and the inequality between provinces will increase three and a half times, but it is only 17% of the overall inequality in China.

The increase of the inequality between provinces occurs under perfect competition because the provinces gain differently. According to Table 8.2, the overall mean

income of China will increase less than two times. Among the eastern, the middle and the western parts, the eastern part will be the big winner, as all ten provinces there will have their income increased. In particular, the six provinces of Beijing, Shanghai, Tianjin, Jiangsu, Liaoning and Guangdong will gain much. The growth rates of income in these provinces are almost double. In the middle part, income increases in five of the nine provinces, with only Anhui and Sanxi featuring growth rates of income well over the average growth rate. However, Jiangxi and Henan, with decreasing income, will lose. In the western part, four of the 11 provinces will have their income increased. In particular, Gansu, Xinjiang, Ningxia and Yunnan will be the big winners, and Guangxi and Guizhou will be the losers.

In the observed markets, there is a negative relationship between income inequality and economic development. But, under perfect competition, this relationship will vanish.

Although Griffin et al. (1994) argued that there was no relationship between income inequality and economic development in either rural or urban areas in provinces, Theil's index in Chapter 4 showed that the inequality within each province was related to its economic development. In the developed provinces, the inequalities between rural and urban areas were less. It was shown, however, that the less developed the province was, the greater the inequality was between rural and urban areas. The overall inequality in each province consists of the inequality between social classes and the inequality between areas. In the current market, the former was not related to economic development, while the latter was. Because the latter contributes significantly to the overall inequality, the overall inequality was therefore related to development in each province. In the competitive market, the share of the inequality between areas in the overall income inequality will decrease; the overall inequality will thus be approached mainly by the inequality between social classes, which is not related to the development.

Unskilled labor will migrate out of the under-developed western part; the less-developed middle part will not be affected, but the developed eastern part will "import" the migration of the western part's unskilled labor. The migration of unskilled labor significantly influences local economies. The provinces from which the unskilled labor and their families emigrate will see an increase in mean income levels, whereas the provinces that welcome the immigrant unskilled labor and their families will experience a decrease in mean income levels.

In Chapter 4, I have introduced the so-called "Hukou", or a special system of

residence registration conducted by the Chinese government. The economic reform has weakened the action of the "Hukou", which has given more freedom to the labor markets. Labor moves under the incentive to survive or to improvethe the standard of life. Currently, the mobility of labor, particularly farmers, is steadily increasing. In current years there have been tens of millions of farmers moving around the country in search of work. Wang et al. (1995) estimated that, at that time, China had in fact 130 million surplus farmers, and that this number would increase to 230 million in the next ten years.

The results of this research in Table 7.3 showed that in the competitive market there would be nearly 86 million unskilled laborers ready to migrate.[2] Table 8.3 shows that total amount of the migrants that is including with the family members,[3] will be about 150 million.[4] Table 8.3 also shows that the provinces with the exodus of unskilled labor will have higher income ranks, and the provinces experiencing immigration will have lower income ranks. In the eastern part, Shanghai, Beijing, Jiangsu and Tianjin will have 37 million immigrants; the other six provinces will have 52 million immigrants, and the net number of immigrants will be nearly 15 million. In the middle part, only Anhui and Sanxi will have numbers of immigrants over 53 million. Neimeng's population will remain constant, as it does not participate in the competitive market; the other six provinces will have 53 million migrants, with the immigrants almost matching the emigrants. In the western part, Xingjiang, Ningxia, Gansu and Yunnan will have over 61 million immigrants, the populations in Hainan and Tibet will remain as constant as Neimeng. The other five provinces will have over 46 million migrants. The western part will have over 15 million net immigrants.

8.2 On the modelling

An important part of this research is the modelling. A good model is a bridge between theory and practice. On the one hand, the model's construction should be theoretically well based; on the other hand, it also should be applicable to real economic problems. The modelling in this research was an exploration in that direction.

Neo-classical economic theory, which provides the basis for the modelling, states

[2]This is the sum of either all the positive or all the negative entries of the column of totals of Table 7.3. The labor substitution figures cancel out.

[3]The family members are accounted for based on the dependency ratios in each province, which are presented in Table 4.1.

[4]This is the sum of either all the positive or all the negative entries of last column of Table 8.3.

Table 8.3 **Migration in the Competitive Economy**

	Mean income	Migration out	Migration inward	Net migration out
Beijing	10361	3154313	0	3154313
Shanghai	8706	1763622	0	1763622
Tianjin	5271	284480	0	284480
Jiangsu	5022	32138700	0	32138700
Liaoning	2659	0	4554553	-4554553
Guangdong	2589	0	8464158	-8464158
Zhejiang	2118	0	5781061	-5781061
Fujian	1471	0	4434715	-4434715
Sandong	1345	0	17137073	-17137073
Hebei	1211	0	11636488	-11636488
Eastern part		37341115	52008048	-14666933
Anhui	4424	47192609	0	47192609
Heilongjiang	1782	0	2962822	-2962822
Sanxi	1662	6240171	0	6240171
Jilin	1242	0	3090346	-3090346
Neimeng	937	0	0	0
Hunan	935	0	12190874	-12190874
Hubei	848	0	9867711	-9867711
Jiangxi	843	0	6760587	-6760587
Henan	696	0	18335609	-18335609
Middle part		53432780	53207949	224831
Gansu	5882	18632325	0	18632325
Xinjiang	5056	8584547	0	8584547
Ningxia	4920	3054507	0	3054507
Yunnan	2565	31128881	0	31128881
Hainan	1290	0	0	0
Qinghai	1228	0	704016	-704016
Tibet	1117	0	0	0
Shanxi	997	0	6040128	-6040128
Sichuan	845	0	24150559	-24150559
Guangxi	784	0	8510678	-8510678
Guizhou	523	0	6857153	-6857153
Western part		61400260	46262534	15137726
China	1618	152174155	151478531	695624

that in a competitive economy, given endowments, preferences and technologies, market forces will automatically drive the economy to the level of efficiency at which the economy maximizes final output and optimally employs resources. The modelling in the research, therefore, attempted to maximize the final product and simultaneously allocate resources optimally. The theory states that in a competitive economy, resources are valued by the marginal productivity. The modelling therefore considered the computation of the marginal productivity.

In brief, the modelling in this research has made some considerable achievements. The model describes a large-scale integrated market, in which a number of sectors and small economies compete with each other. More specifically, there are 810 sectors and 27 economies. As a result of the competition, some sectors and economies would expand, some shrink, and some even disappear. The modelling reallocated resources among sectors and economies, so that the final product was maximized in the economy. In particular, it captured labor substitution and migration. This was a speciality of the modelling in this research. The modelling determined the prices of resources and commodities, and therefore revealed the functional income distribution under perfect competition.

In spite of these achievements, the modelling has some limits, which need be improved in future research. First, the objective is not the real final product, it is only a part of the final product. By definition, the final product consists of consumption, investment and net export. The modelling considers the net export as an external resource; therefore, the objective, in fact, includes only consumption and investment. If the model incorporates the net export into the objective, then it must also consider the economy outside the integrated economy.

Second, the assumption that fixed capital is sector specific is too strong. In fact, fixed capital can be divided into two types: specific and common fixed capital. Specific fixed capital is the capital designed specifically or for special uses; medical machines, for example, become useless out of the sector, and can therefore be assumed to be sector specific. Common fixed capital is capital for common uses; the buildings, for example, computers and office facilities – this type of capital can be mobile among sectors or even among locations.

Third, the assumption that the technician is mobile among sectors is not precise enough. The technician may also be divided into two types: the specialist and the general technician. A special technician, a veterinary surgeon in agricultural sector, for example, is unable to find proper position in other sectors; an engineer in farming

machinery, however, may do so.

Fourth, because the main part of the model is a linear program, it is affected by the limits of linear programming that the number of non-zero shadow prices is determined by the number of independent constraints in the linear program. In other words, the fewer the number of independent constraints, the more zero shadow prices. To avoid the problem, one may choose to use a non-linear program.

Fifth, the model makes no direct connection with personal income distribution. In this research, the model is confined to generating a functional income distribution; it does not incorporate a personal income distribution. The research investigates personal income distribution only empirically. For research that is intended to investigate personal income distribution, it may be convenient and comprehensive to model the functional and personal income distribution together. Especially if the research is concerned with policy making and the optimal pattern of income distribution, the model has to capture the feedback effects; it therefore needs to consider various aspects such as population composition, government intervention and family structure together.

8.3 On the empirics

This research put a lot of effort inon the empirics. It dealt with hundreds of thousands of data and employed a number of advanced computing methods and computer programs to compute the model and to calculate the personal income distribution. Because the existing data were insufficient for the requirements of the research, the empirics were meant to derive, to estimate and assume the data that were unavailable by referring to relevant information sources and the literature. Because the model included a large-scale linear program, normal computer programs and mathematical methods were not enough to compute the model. The empirics had to adopt the sparse matrix method to handle this problem. However, the empirics still retain some problems.

First, because information on capital utilization does not exist in China, the empirics had to substitute the capital for production for the capital utilization in industrial sectors. Certainly, the two are vastly different, at least in definition. But, my experience leads me to conject that the two may have many things in common in Chinese statistics. In the sectors of agriculture, commerce, construction, finance and banking, education, and public administration, the rates of capital utilization are estimated

very roughly by referring to the literature and to other partial information sources.

Second, the empirics assumed that labor was employed fully in the observed markets, which in fact was not true. There may be a certain amount of unemployment in the markets. However, because unemployment is not well defined in China, information on the term is rather rare and untrustworthy. Especially in rural areas, it is hardly possible to distinguish between employment and unemployment. And, in urban areas, the low unemployment rate released by official authorities is highly improbable because it is far away from public's feeling on the markets.

Third, it was not realistic enough to assume that the capitalist is the sole earner of capital income in the empirics. Apparently, other classes of people may also hold a certain amount of private capital, and earn the income. If the empirics could have included this part of income, the results would have been more precise, and might have drawn some different conclusions.

Fourth, because of the lack of micro-data this research was unable to investigate income differences within social classes; the absence of the information about income inequality within social classes has inevitably kept us from drawing explicit and deep conclusions. A way to counteract this weakness may be to further divide social classes into subclasses according to income levels or ages with the assistance of relevant micro-data.

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Samenvatting

Het is een opmerkelijk feit dat, waar wereldwijd vele economieën stagneren, de socialistische economie van China de afgelopen jaren aanmerkelijk is gegroeid. Dit wordt, onder anderen door economen, toegeschreven aan de markt-georiënteerde hervormingen die daar in 1978 zijn begonnen. Momenteel maakt men goede vorderingen met de hervormingen, niettegenstaande het feit dat China nog een lange weg te gaan heeft naar een markteconomie. De vraag hoe lang die weg is, en op welke manieren de markthervormingen de Chinese economie zullen beïnvloeden, ligt ten grondslag aan deze monografie. Op basis van een model van een hypothetische Chinese markteconomie zal getracht worden om inzicht in deze vraagstukken te krijgen.

De monografie belicht een bepaald aspect van de economie, namelijk de verdeling van de private inkomens; specifiek, de invloed van een markteconomie daarop. Daarbij is de discussie opgebouwd rond drie thema's. Ten eerste, de huidige situatie met betrekking tot de private inkomensverdeling. Ten tweede, de verandering van de verdeling als gevolg van economische hervormingen. Ten derde, de rechtvaardigheid van de verdeling.

Het onderzoek in deze monografie gaat uit van de vooronderstelling dat fundamentele economische variabelen het inkomen bepalen, en de functionele met de private inkomensverdeling verbinden. Aangenomen wordt dat het private inkomen bepaald wordt door private beginvoorraden, meer specifiek door de prijs van beginvoorraden, gegeven vaste eigendomsrechten hierop. Volgens de neo-klassieke theorie van de functionele inkomensverdelingen bepaalt in een markt met volledige mededinging de marginale produktiviteit van een goed diens prijs. Omgekeerd is het private inkomen afleidbaar als de goederenprijzen eenmaal bekend zijn. Om die reden is de kern van deze monografie het afleiden van een evenwichtige inkomensverdeling in een mededingingseconomie. In de eerste plaats wordt daartoe een algemeen evenwichtsmodel geconstrueerd en opgelost, waarin lonen en rentevoeten gekoppeld zijn aan de marginale produktiviteit van arbeid en kapitaal, respectievelijk. Vervolgens

wordt de functionele inkomensverdeling omgezet naar een private inkomensverdeling.

In het algemeen evenwichtsmodel wordt China voorgesteld als een geïntegreerde economie met wereldwijde handelsbetrekkingen. Internationale handelsstromen worden daarbij als gegeven beschouwd. Het doel van de planner van deze economie is om de netto binnenlandse consumptie te maximaliseren. In het model is China opgedeeld in dertig provincies, die ieder op zich een onafhankelijke economie vormen. Iedere provincie wordt op zijn beurt gekarakteriseerd door dertig goederen- en dienstensectoren. Tussen de provincies is volledige vrijhandel in goederen en diensten, met uitzondering van de dienst 'openbaar bestuur', die provincie-specifiek is.

Voor de productie van goederen en diensten wordt gebruik gemaakt van arbeid, kapitaal en tussenproducten. Kapitaalgoederen worden daarbij als sectorspecifiek beschouwd. Arbeid wordt geklassificeerd op basis van scholing; vier niveaus worden onderscheiden, namelijk 'ongeschoold', 'geschoold', 'manager', en 'technicus'. Aangenomen wordt dat arbeid een mobiele produktiefactor is. Het model beschouwt drie soorten substitutie: tussen hogere en lagere scholingsniveaus, tussen sectoren, en tussen regio's. Volgens de theorie van het menselijk kapitaal komen verschillende scholingsniveaus overeen met verschillende niveaus van marginale produktiviteit, waarbij hoger geschoolde arbeid lager geschoolde arbeid kan vervangen. Het model in deze monografie beschouwt de volgende substitutie-hiërarchie tussen scholingsniveaus: een technicus kan alle andere niveaus vervangen, een manager kan geschoolde en ongeschoolde arbeiders vervangen, en een geschoolde arbeider kan een ongeschoolde arbeider vervangen.

Arbeid is ook mobiel tussen sectoren. Daarbij wordt verondersteld dat arbeiders uitsluitend over zullen stappen naar een andere sector indien zij in de bestaande sector een inkomen verdienen gelijk aan nul. Dit betekent dat geschoolde arbeiders niet naar een andere sector zullen overstappen, maar genoegen zullen nemen met een een lagere positie, als hun werk in een bepaalde lokale markt overbodig wordt. Ongeschoolde arbeiders kunnen echter geen hoger geschoold werk aannemen, zodat zij altijd zullen overstappen als hun werk overbodig wordt. Met andere woorden, technici, managers en geschoolde arbeiders zijn mobiel tussen de sectoren van een provincie, en ongeschoolde arbeiders zijn mobiel over geheel China.

Het model wordt geanalyseerd op basis van data die betrekking hebben op de Chinese economie van 1992. De aanwezigheid van competitie in het model draagt er zorg voor dat grondstoffen efficiënt gealloceerd worden, en dat sectoren een optimale omvang aannemen. De empirische studie in deze monografie vergelijkt de

geobserveerde allocatie in de Chinese economie met de efficiënte uitkomst. De belangrijkste uitkomst van deze vergelijking betreft de functionele inkomensverdeling. Namelijk, als grondstoffen volledig worden benut, worden ze gewaardeerd tegen hun marginaal product, gelijk aan de efficiënte rente- en loonvoeten. Dientengevolge is ook de private inkomensverdeling efficiënt, gegeven de eigendomsrechten op grondstoffen.

De inkomensongelijkheid in de werkelijke en de hypothetische Chinese economie wordt gemeten met behulp van een uitbreiding van de index van Theil. Daarbij wordt zowel de ongelijkheid in de economie als geheel, als de ongelijkheid tussen sociale klassen, in en tussen gebieden, en in en tussen regio's gemeten. Het belang van de resultaten is gelegen in het vergelijken van de mate van inkomensongelijkheid in mededingingsmarkten. In het bijzonder worden zowel de geobserveerde als de hypothetische private inkomensverdeling afgeleid.

Het voornaamste resultaat van deze monografie is dat zij zowel de geobserveerde als de hypothetische private inkomensverdeling naar voren brengt. In de overgangsperiode van de huidige Chinese economie naar een markteconomie zal de private inkomensverdeling ingrijpend veranderen. In het bijzonder zal de inkomensongelijkheid tussen de sociale klassen groeien. Dit komt door het overvloedige aanbod van ongeschoolde arbeid gecombineerd met een tekort aan geschoolde werknemers. Indien arbeid wordt beloond naar haar marginale productiviteit, zal een geschoolde werknemer veel meer verdienen. Als gevolg van het toenemen van mededinging in de markt gaan technici, managers en grote ondernemers erop vooruit, terwijl de ongeschoolde arbeiders en eenmans-ondernemingen erop achteruit gaan. Tevens zal de inkomensongelijkheid tussen regio's en provincies toenemen, ook al neemt hun aandeel in de algehele inkomensongelijkheid af. Deze ongelijkheid wordt grotendeels veroorzaakt door de migratie van ongeschoolde arbeiders. De stedelijke regio's zullen er in alle provincies op vooruit gaan. De plattelandsregio's daarentegen gaan er sterk op vooruit in zes provincies, redelijk in negen provincies, en gaan erop achteruit in twaalf provincies. Oost-China gaat er sterk op vooruit: het inkomen in alle provincies in dat deel van het land stijgt.

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Female Labor Supply
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in de aula van de
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Graag nodig ik u uit to
het bijwonen van de
promotieplechtigheid e
de aansluitende recepti

Trea Laske-Aldershof
Bakkumstraat 31
5043 XW Tilburg
013-5701999

Haoran Pan received his Bachelor and Master degrees in economics at Liaoning University and Renmin University in China, respectively. He joined the Ph.D. program at the Department of Econometrics and CentER for Economic Research of Tilburg University in 1993. His research interest has been in empirical economics, especially for developing economies.

This thesis applies a computable general equilibrium model to China to explore what perfect competition would do to income distribution in China. The research analyzes this question by determining personal income distribution under hypothetical, perfectly competitive conditions, where factors are rewarded according to their marginal productivities. Comparison with the observed personal income distribution reveals dramatic changes. In particular, the income inequality between social classes will grow. The income inequalities between areas and provinces will also increase, even though their shares in the overall income inequality will decrease. Competition would dissolve the existing negative relationship between the levels of economic development and of income inequality across provinces.

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